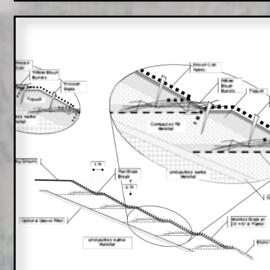
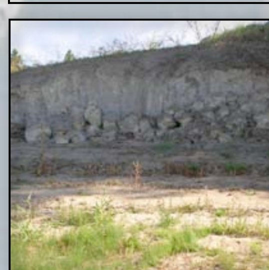
Pend Oreille River in the Box Canyon Reservoir

Riverbank Stabilization Guidelines





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Riverbank Stabilization Guidelines

Final

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Prepared for:

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1. PURPOSE OF THIS DOCUMENT

The Washington Department of Fish and Wildlife (WDFW) is responsible for regulatory review and approval of riverbank stabilization measures implemented on private and some public land within the state through the Hydraulic Project Approval (HPA). Increased land development along the Pend Oreille River within the 54-mile long Box Canyon Reservoir (Figure 1) and high rates of riverbank erosion have led to the implementation of a large number of bank stabilization projects in recent years. Most of these projects have not accounted for protecting environmental conditions and have not incorporated measures to mitigate for environmental impacts. This document is intended to provide guidance to assist the public with identifying the causes of riverbank erosion along their property and selecting environmentally appropriate design options in order to gain WDFW approval. In addition to an assessment framework and technique selection process, this guideline includes a detailed description of five bank stabilization techniques that have the support of WDFW. Therefore, landowners who submit HPA applications that appropriately utilize these techniques will be proposing measures endorsed by WDFW.

Figure 1. Location of Pend Oreille River within the Box Canyon Reservoir, between Box Canyon Dam downstream of Ione and Albeni Falls Dams upstream of Newport.

2. REACH ASSESSMENT

Introduction

This chapter describes reach-based processes that result in riverbank erosion along the Pend Oreille River through Box Canyon Reservoir. It provides a characterization of the basic physical conditions along the reach of the river within the reservoir. The reach-based assessment complements the site-based assessment described in the following chapter (Chapter 3). This reach assessment attempts to answer the following questions:

1) What are the basic physical conditions of the river?
2) What are the natural and human-induced processes that are causing and unstable riverbank?

The reach assessment addresses the river hydrology and the soils and vegetation surrounding the reservoir.

Hydrology

Box Canyon Dam

The Pend Oreille River within the Box Canyon Reservoir is regulated by the Box Canyon Dam. The dam is a run-of-the river hydroelectric facility, owned and operated by the Pend Oreille County Public Utility District No. 1 (PUD). The river water surface can be raised or lowered by controlling the release of water at the dam. Generally, the spillway gates at the dam are raised when the river flow rate increases, and lowered (put back in place) when the flow rate decreases. A naturally-occurring narrows in Box Canyon (about 150-200 feet wide), located about one-half mile upstream from the dam, affects the upstream water surface elevation of the reservoir all the way to Newport at higher discharges.

River Flow

Peak flows in the Pend Oreille River below Albeni Falls occur in May and June and are the result of annual runoff above Albeni Falls Dam. Peak flows typically range from 50,000 to 90,000 cfs. All gates at Albeni Falls Dam are removed during high flow periods exceeding 90,000 cfs. Flooding along the Pend Oreille River begins at a flow of 100,000 cfs. Figure 2 shows an annual hydrograph of mean monthly flows of the Pend Oreille River near Ione.

Recurrence Interval

At Box Canyon Dam, a flow of 154,000 cfs is the 100-year flood flow. This flow has a 1 in 100 chance of occurring in any given year. A 100-year flow is said to have a recurrent interval flow of 100 years (even though such a flow can happen more frequently). At the dam, a flow of 85,300 cfs is the 2-year recurrent flow (which is likely to happen every other year). Recurrence intervals for the river at the Albeni Falls and Box Canyon dams are listed in Table 1.

Figure 2. Annual hydrograph of mean monthly flows of the Pend Oreille River near Ione.

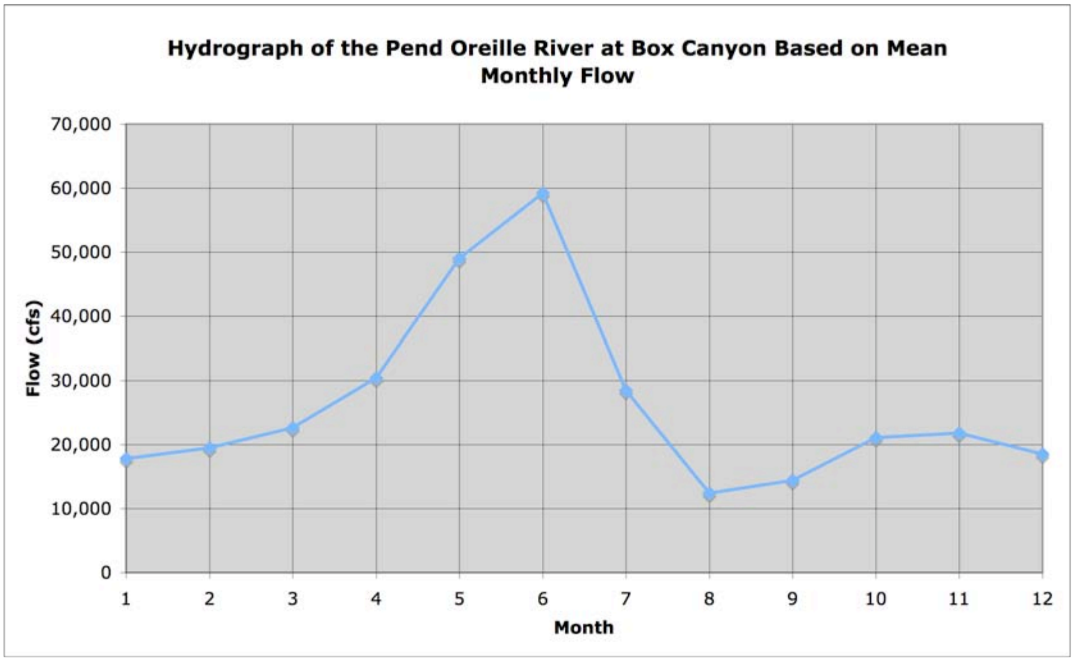


Table 1. Recurrence intervals for the Pend Oreille River at Newport and Ione.

Station No.	Station Name	Period of Record	2-Yr Flow (cfs)	10-Yr Flow (cfs)	25-Yr Flow (cfs)	50-Yr Flow (cfs)	100-Yr Flow (cfs)
12395500	Pend Oreille River at Newport, WA	1953 to 1992	82,600	124,000	140,000	149,000	157,000
12396500	Pend Oreille River nr Ione, WA	1953 to 1992	85,300	124,000	138,000	147,000	154,000

Flow Duration

Flow duration curves, developed from river gage records, show the amount of time a particular flow is equaled or exceeded in a given period. Figure 3 shows the flow duration curve for the Pend Oreille River near Ione. A flow of 50,000 cfs, for example, has a duration of about 10%, which means that on average that rate of flow (or greater) will occur for a total of about 36 days annually (10% of 365 days). The hydrograph (Figure 2) shows that flows of 50,000 cfs and greater typically occur during May and part of June for about 36 days.

Annual Peak Flows

The instantaneous peak flows in the river are measured at the gage near Ione. During the period of record (1948 to 2005), flows have ranged from about 28,000 cfs to 167,000 cfs (note that a flow of 167,000 cfs, recorded in 1948, is greater than the 100-yr flow (as shown in Table 1). The trend line in Figure 4 shows that over the period of record, the magnitude of peak flows has been declining (calculation of the trend line does not include the flow of 167,000 cfs that occurred in 1948).

Figure 3. Flow duration curve for the Pend Oreille River near Ione.

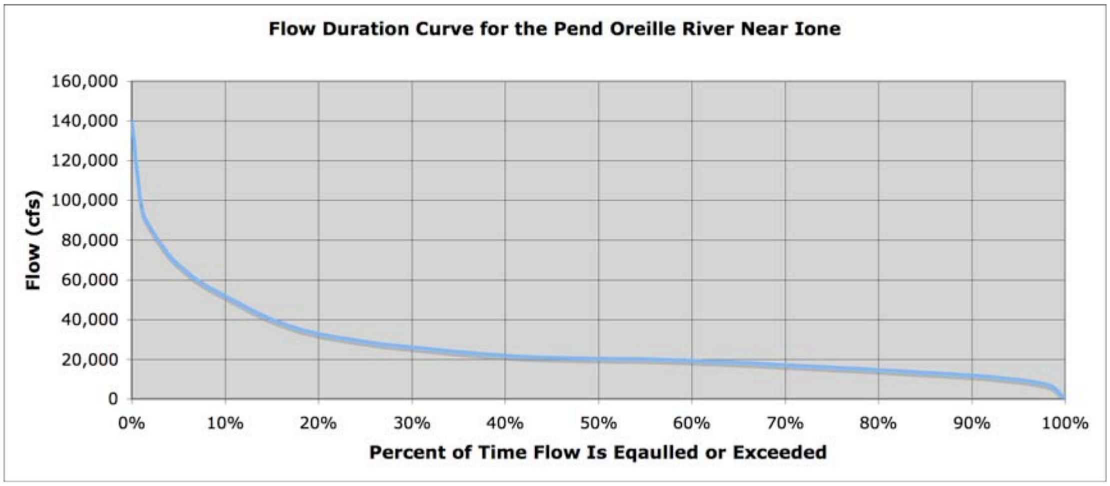
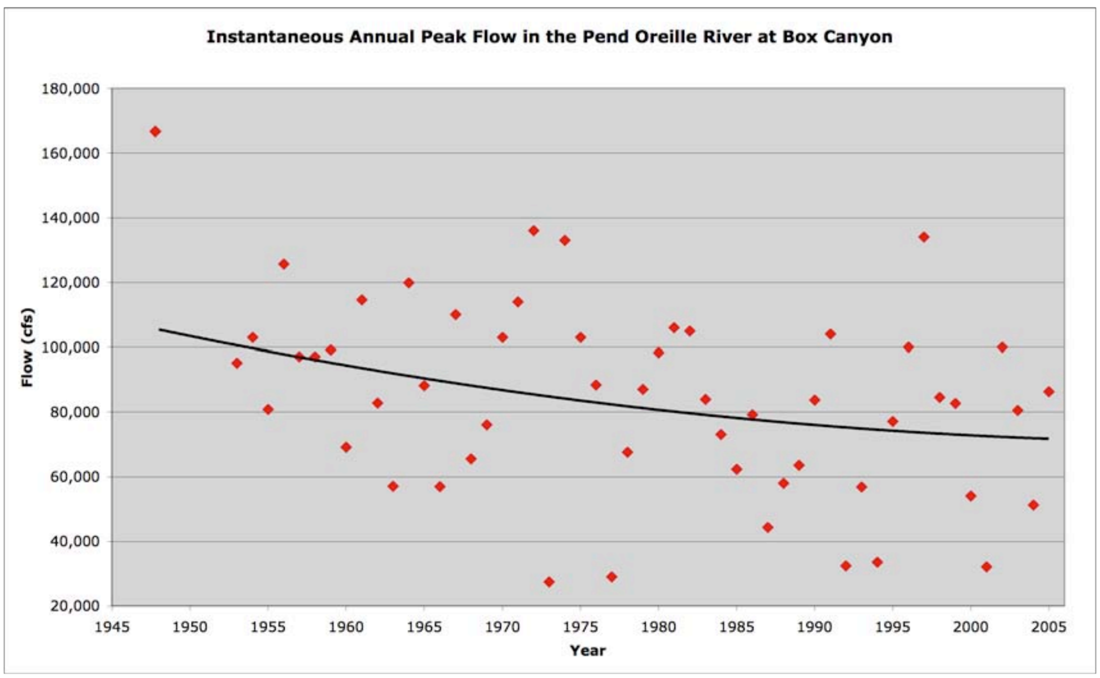


Figure 4. Instantaneous peak flows of the Pend Oreille River near Ione for the period of record (1948 to 2005). The black line is the trend line, and does not reflect the peak flow of 167,000 cfs in 1948.



Water Surface Level Variation

As described previously, the Box Canyon Dam and a narrow segment of the reservoir just upstream from the dam affect the water surface of the reservoir. The water level in the reservoir changes relative to river flow rate and location within the reservoir. These water surface variations affect riverbank erosion and guide the configuration of riverbank stabilization techniques that should be used. The application of these concepts is addressed in Chapters 3 and 4.

The PUD has calculated the relationship between the river flow and the river water surface level relative to the distance from the dam for the range of flows up to 80,000 cfs. This river elevation-discharge relationship is shown in Table 2.

Table 2. Calculated river water elevation-discharge relationship for the Pend Oreille River relative to river mile.

	Water Surface Elevation (Mean Sea Level in feet) at River Mile							
Flow (cfs)	Ione	Tiger Slough Outlet	Blueslide	River Bend	Cusick	Dalkena	Marshall Cr	Newport
River Mile	RM 38	RM 45	RM 52	RM 60	RM 70	RM 77	RM 84	RM 88
10,000	2030.3	2030.3	2030.4	2030.6	2030.8	2030.9	2031.3	2031.6
20,000	2031.5	2031.6	2031.8	2032.4	2032.7	2033.0	2033.7	2034.3
30,000	2032.3	2032.6	2033.2	2034.2	2034.6	2035.0	2035.8	2036.7
40,000	2032.7	2033.2	2034.0	2035.6	2036.1	2036.7	2037.6	2038.6
50,000	2032.8	2033.6	2034.7	2036.9	2037.4	2038.2	2039.3	2040.3
60,000	2033.3	2034.4	2035.9	2038.4	2039.0	2039.8	2040.9	2042.0
70,000	2033.9	2035.2	2037.0	2039.9	2040.6	2041.5	2042.6	2043.6
80,000	2031.8	2033.7	2036.6	2040.2	2041.0	2042.2	2043.5	2044.6

The mean annual fluctuations in water surface within the reservoir vary from as little as 3 feet at Ione to as much as 10 feet near Newport (Figure 5). During dry years, the fluctuations can be as little as 2 and 5 feet in Ione and Newport, respectively. During wet years, the fluctuations at Ione do not change significantly, while in Newport the stage can vary by 14 feet or more. Determining the seasonal variations in river stage at a particular location in the reservoir is necessary to assess the effect of river stage fluctuation on riverbank erosion and to develop appropriate bank stabilization measures. Figure 6 depicts the seasonal water level in the river at different locations within the reservoir, based on mean monthly flows at the Ione gage. *Appendix 1 Stage Variation* includes seasonal water elevation variation based on mean, "wet" and "dry" years for a series of sites within the reservoir. This information can be used to determine river level variation at a particular eroding riverbank.

Figure 5. Annual variation in water surface level along the Box Canyon Reservoir. Mean annual flow is compared to data for "wet" and "dry" years of record to show the range of water levels that can occur.

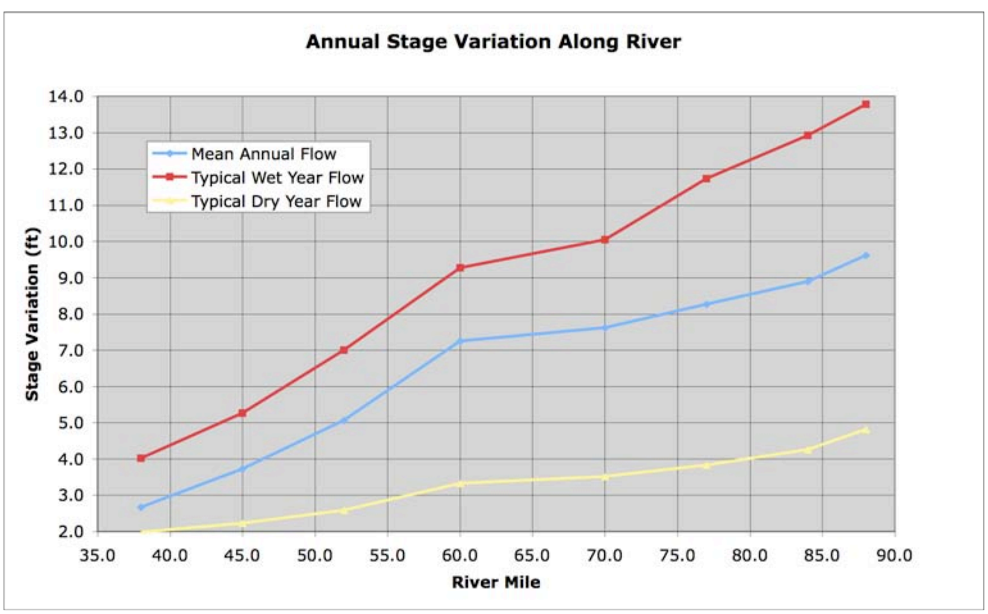
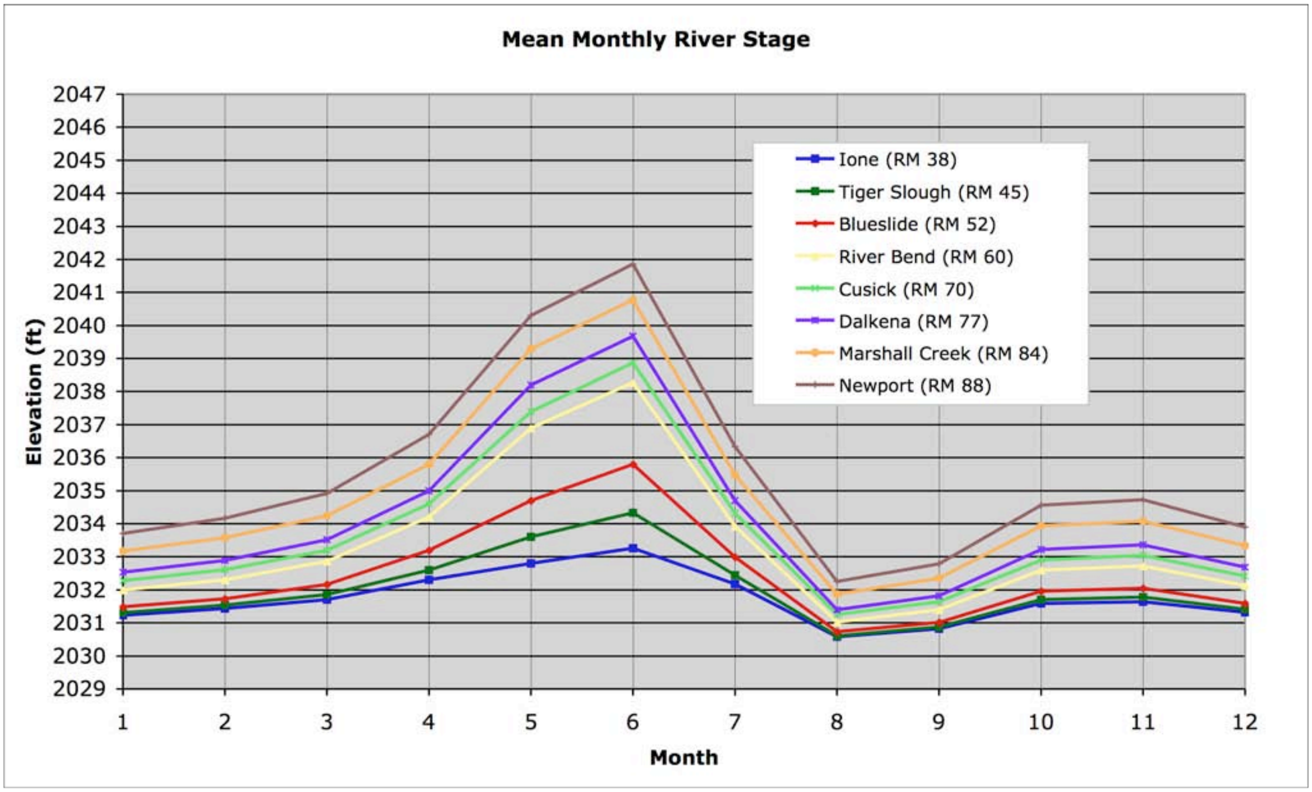


Figure 6. Seasonal water level variation at different locations within the Box Canyon Reservoir, based on mean monthly flows at the gage near Ione. See *Appendix 1 Stage Variation* for more information on seasonal water surface variation at different locations.



Soils

The Natural Resources Conservation Service has mapped the soils along the shoreline of the Box Canyon Reservoir. There are a few segments of riverbank that consist of exposed bedrock. The remaining riverbank soils are loams of two general categories. Loam is soil composed of sand, silt and clay in relatively even concentration. Loams are gritty, plastic when moist, and retain water easily, yet they drain well where the topography allows. Loams with slightly different proportions of sand, silt and clay have names that reflect the predominant component: silty loam has a higher percentage of silt, clay loam has more clay, silty clay loam has more silt and clay, and sandy loam has more sand.

By far the most prevalent soil type along the Box Canyon Reservoir consists of silt loams and silty clay loams. These soils retain moisture and drain more slowly than soils with a higher percentage of sand. Riverbanks consisting of silt and silty clay loams will maintain a near-vertical slope and are susceptible to slumping due to rapid drawdown and internal seepage. The remaining soils along the reservoir are higher in sand and include sandy and fine sandy loams. These soils drain rapidly, tend to reach a stable angle of 1:1 (H:V) or gentler and are not susceptible to slumping (because drainage is not an issue).

In terms of soils for riverbank stabilization, loamy soils provide good conditions for establishing vegetation because they hold plenty of moisture but also drain well (so that sufficient air can reach the plant roots). A certain amount of clay is a desirable constituent of soil, since it binds other kinds of particles together and contributes to retaining water.

Excessively clayey soils, however, are exceedingly difficult to cultivate. Their stiffness impedes the growth of the plants and prevents free circulation of air around the roots. They are cold and sticky in wet weather, while in dry weather they bake hard and crack. Highly sandy soils are also less productive than loamy soils because they do not retain water and contain few nutrients. The importance of soil type in evaluating riverbank stability and determining appropriate stabilization measures is further addressed in Chapters 3 and 4.

Vegetation

Terrestrial Vegetation

The northern (downstream) portion of the river corridor from the Box Canyon Dam (RM 34.0) upstream to about RM 66 is classified as being within the Western Hemlock Vegetation Zone. Western red cedar is a major species in this zone, and grand fir is an important intermediate species. Sitka alder is characteristic at moist sites in this zone, including riparian areas. Quaking aspen and paper birch are intermixed in some conifer stands. Shiny-leaf spiraea, red-twig dogwood and willows occur on wetter sites at tributary confluences.

The southern (upstream) river corridor from about RM 66 to Albeni Falls Dam (RM 90.1) lies within the Ponderosa Pine Vegetation Zone (broadly defined to include areas where persistent, fire-maintained ponderosa pine forests predominate). Within this zone, groves of black cottonwood and quaking aspen typically occur on riparian or poorly-drained sites. Other representative conifer tree species in this zone are Douglas-fir, western larch and grand fir. Lodgepole pine is a common species on burned-over sites. Representative shrub species in this zone include snowberry, shiny-leaf spiraea, and rose. On more moist sites in the zone, ninebark, western serviceberry, and black hawthorn are typical.

Aquatic Vegetation

Abundant, dense beds of aquatic plants are prolific in the Pend Oreille River within the Box Canyon Reservoir because of the extensive shallow water and bed sediments exposed to sunlight. Proliferation of the exotic Eurasian watermilfoil (*Myriophyllum spicatum*) in the 1980's altered the aquatic plant composition in the reservoir. Aquatic plant biomass in the river—largely watermilfoil—peaks in mid-August, coinciding with peak water temperature. Aquatic plant biomass in sloughs peaks one month earlier (in mid-July).

Watermilfoil produces many seeds, although these seeds are not important for milfoil reproduction. Watermilfoil is able to reproduce very successfully and rapidly through the formation of plant fragments. In the late summer and fall the plants become brittle and naturally break apart. A new plant can start from a tiny piece of a milfoil plant.

A rotovation (underwater rototilling) program to manage milfoil around boat docks has been in place since 1986 in the Pend Oreille River through the Box Canyon Reservoir. As of 1995, approximately 200 acres per year were being treated. Rotovation is done year-round, weather and river conditions permitting. Treatment areas are rotovated, on average, every 18-24 months. Rotovation is done using a boat-mounted Aquamog™ 8-foot long tiller. The effective operational depth is 16 to 18 ft, which is capable of reaching most all watermilfoil habitat. A two-pass rotovating treatment is typically employed; the first pass is parallel to the shore and the second pass is perpendicular to shore. Additional rotovating may be done if the post treatment inspection detects areas missed. It was reported in 1999 that cut plants were not collected, but current operations often include some shoreline disposal of cut plant material. Watermilfoil regrows relatively quickly; some studies have shown total regrowth in 30 to 60 days while other studies indicate that rotovation may provide reduced biomass for a growing season.

Reduced offshore water depth caused by the growth of aquatic vegetation may have an effect on limiting the effects of wave action at lower flows. The dense aquatic plants that grow in shallow, near-shore zones may reduce the magnitude of waves and the associated effects of erosion.

3. SITE ASSESSMENT

Introduction

This chapter describes why riverbanks fail along the Pend Oreille River through Box Canyon Reservoir. Identification of these mechanisms allows one to identify the causes of erosion, and then select appropriate bank stabilization measures. The site-based assessment complements the reach-based assessment described in the preceding chapter (Chapter 2). Guidance is also provided in this chapter to help landowners collect information to determine site location, riverbank condition, and mechanisms of failure for a specific site.

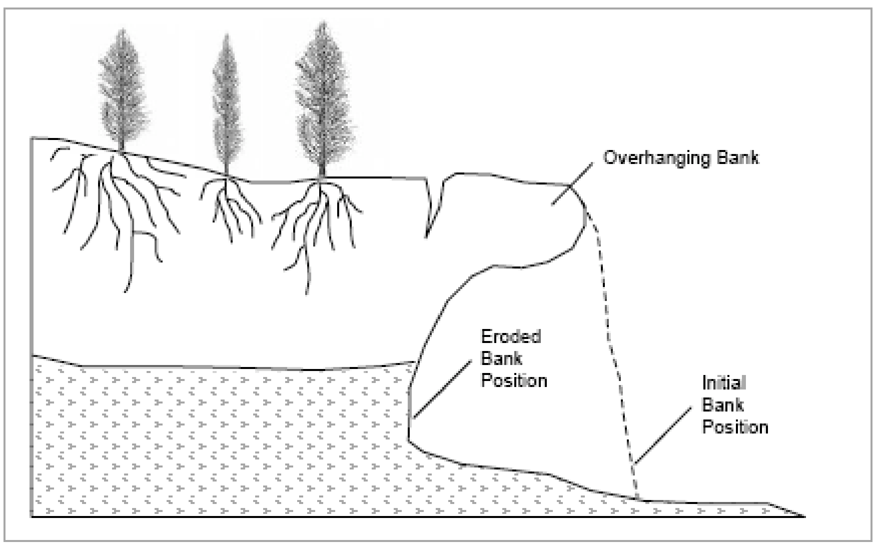
Mechanisms of Failure

A mechanism of failure is defined as a physical process of erosion. There are several mechanisms of failure causing erosion of riverbanks along the Box Canyon Reservoir. These mechanisms are described in the following subsections.

Toe Erosion

Toe erosion occurs where water flow removes particles from the streambank and bed, undermines the bank toe, and causes failure of overlying layers (Figure 7). In actuality, the term "toe erosion" is not entirely accurate, since the undermining may occur above the toe, depending on site conditions and causes.

Figure 7. Toe erosion.



Toe erosion occurs intermittently throughout the Box Canyon Reservoir. There are several causes of toe erosion, although toe erosion along the Pend Oreille River primarily caused by disturbance and removal of riverbank vegetation, primarily that of woody vegetation, and wave action.

Vertical to near-vertical riverbanks, ranging in height from a few feet to over 40 feet, have formed along the river as a result of toe erosion and subsequent gravity collapse of the banks. Such bank failure typically occurs when cohesive silty/clayey soils are undercut. This failure process acts to temporarily reduce and normalize these oversteepened conditions, but subsequent removal of materials from the base of these slopes through toe erosion regenerates them as vertical slopes. The erosion process continues, with bank retreat resulting from subsequent toe erosion and bank collapse. Vegetation along the top of the bank does not play a role in preventing erosion at the toe of the slope.

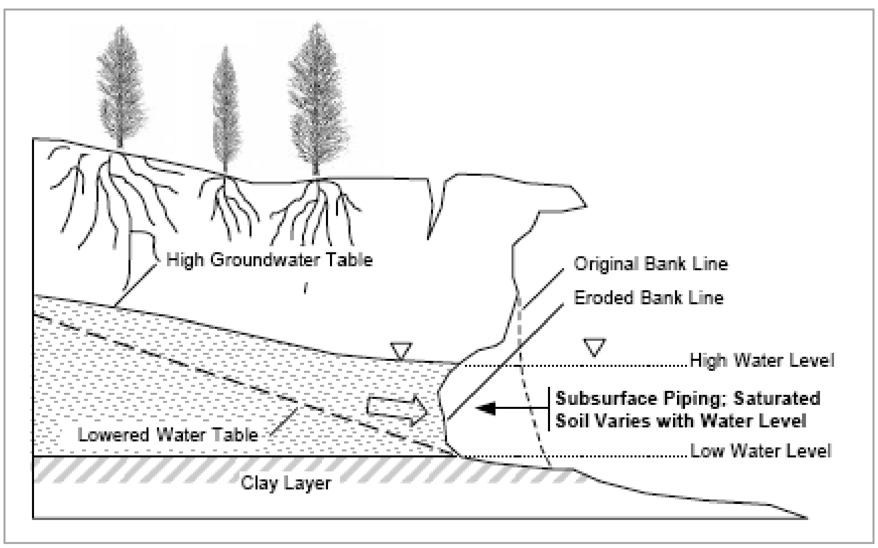
Scour

Scour is localized bed erosion that is greater than erosion found at other nearby locations of the streambed and bank. There are several different types of scour commonly found in unregulated rivers. Generally, only local scour occurs in the Pend Oreille River within the reservoir. Local scour is a function of water depth and water surface slope. While the water surface slope in the river is very small (less than 6 inches per mile), water depth during high flow can be significant (40 to 50 feet). Nonetheless, the forces of scour, even at extreme flows in the river, are very small; shear stress does not exceed 0.2 lbs/ft^2. As such, local scour along the banks of the Pend Oreille River within the reservoir can be considered relatively insignificant.

Bank Seepage Flows and Piping

Water seeping through a riverbank can entrain soil particles, through a process called piping. This process occurs when subsurface flow loosens soil particles until small tunnels develop (Figure 8). These tunnels reduce the cohesion of soil layers, thereby causing slippage and ultimately bank erosion. Changes in river water level, (which, when it occurs quickly is called rapid draw down) and groundwater seepage (which can be the result of natural subsurface flow or human-induced by landscaping, irrigation and drainage pattern alteration) are common causes of piping. Excessive irrigation of residential lawns and agricultural fields can also cause groundwater seepage. Bank erosion from piping is evidenced as localized small failures and undermining where areas of saturated soil liquefy and fail due to the positive pore pressure from groundwater.

Figure 8. Bank seepage and piping.



Mass Failure

Mass failure is the downward movement of large and intact masses of soil and rock. It occurs when the down-slope shear stress (weight) exceeds the shear strength (resistance to weight) of the earth material. Shear stress is the driving force from gravity and/or loads acting on the slope. Shear strength is the characteristic of soil, rock and root structure that resists a unit of material sliding along another. Any cause that increases the shear stress or conversely decreases the shear strength can cause a mass failure. The majority of mass failures are triggered by water saturating a slide-prone slope.

Mass failure is most likely to occur in wet, cohesive soils where at least part of the slope is saturated. Mass failures often exhibit as slumps and earthflows in near-saturated circumstances and as soil materials liquefy. Shorelines within the Box Canyon Reservoir exhibit slump and earthflow failure in two forms: relatively small bank failures (the more common form) and larger, more deep-seated failures (which are relatively rare along the reservoir). Slumps are evident as masses of soil that have slid down a slope, often with intact collections of trees and shrubs. Slumps with trees are recognizable because the trees lean at an angle; large slumps with numerous trees are often seen with trees leaning in different directions.

Site-Based Causes of Riverbank Erosion

Vegetation Disturbance and Removal

Disturbance and removal of woody vegetation in the riparian area can adversely affect riverbank stability. Plant roots on the riverbank slope bind the soil together into a monolithic mass. The roots penetrate through the soil into firmer strata, thus anchoring the soil to the slope. Riverbanks that support woody vegetation are generally much more stable than those where vegetation has been removed or disturbed. Several contiguous riverbanks demonstrate this point: stable banks covered with dense willow are juxtaposed against unstable, eroding banks where vegetation has been removed. Disturbance and removal of woody vegetation is the major cause of riverbank failure along the margins of the reservoir.

Landowners typically exacerbate this problem by clearing vegetation to build structures (homes and outbuildings), create open areas, provide views of the river, gain shoreline access (via steps and docks), and “clean up” the riverbank. Some landowners consider natural conditions of growing, dead and downed woody vegetation on a bank as unsightly; they clear woody vegetation in an effort to landscape a riverbank. In doing so, they often compromise bank stability and put their adjacent homes at risk.

If the riverbank is at a stable angle, then vegetation consisting of no more than grasses will, in some cases, provides a high degree of stabilization. However, removal of woody plants in order to establish a uniform cover of grasses will generally reduce the level of bank protection. Woody plants and grasses together provide the greatest degree of stabilization.

Rapid Drawdown

With prolonged high water conditions in the reservoir, soils in the riverbank become completely saturated and fully consolidated under the weight of the overlying material. If the reservoir pool is subsequently drawn down faster than the water can escape the bank, then high residual pore water pressures develop in the bank. These pressures can lead to bank failure in the form of soil piping and slumping, failure mechanisms described previously. Clay soils, common to the margins of the Box Canyon Reservoir, are particularly susceptible to these conditions because they drain slowly. Rapid drawdown can occur from adjustment of the control gates at Box Canyon and Albeni Dams and from rapid decrease in flood flows, and a combination of the two conditions.

Wave Action

Waves in Box Canyon Reservoir cause toe erosion by dislodging soil particles and undermining riverbanks. Waves are a result of wind and motorboat wakes and are influenced by fetch and river bottom conditions. Fetch is the distance a wind-induced wave travels. In areas where fetch distances are small, waves are generally smaller than where fetch distances are larger. For example, waves produced by wind blowing across the reservoir, where fetch distance is less than 1,000 feet, are smaller than waves produced by wind blowing the length of the reservoir, where fetch distance is several miles. Waves are also caused by wakes created by motorboats. Where motorized recreation is popular in the reservoir, boat-caused waves can be common.

River bottom conditions also affect the configuration of waves. As waves approach a shallow shoreline, friction from the river bottom slows the lower part of the wave, while the upper part continues to move forward. The wave breaks before it reaches the riverbank, with much of the erosive energy expended on the river bottom. Aquatic vegetation like watermilfoil can have the same effect, causing waves to break before they reach the bank. Where riverbeds are deep, the full force of waves is expended on the adjacent riverbank, resulting in higher erosive forces than where river bottoms are shallow or aquatic plats are extensive.

Woody material, such as trees that have fallen along a shoreline, can serve to reduce the effects of wave action. Fallen trees also trap dislodged sediments so that grasses and sedges can become established. Willow and sedges growing along a riverbank can absorb the force of waves, preventing bank erosion.

Freeze-Thaw

Freeze-thaw is a daily cycle of alternate freezing and thawing of pore water in a surface soils of a riverbank. Ice expansion during the freeze cycle dislodges surface materials; during the subsequent thaw these materials roll to the toe of the slope. This process causes bank erosion above the river water level. Eroded upper bank material is subsequently carried away from the bank toe by the process of toe erosion. Vertical, unvegetated slopes high in clay are prone to the effects of freeze-thaw, while flatter, well-drained slopes supporting vegetation exhibit only minimal effects of freeze-thaw.

Ice

Ice can form on the surface of the river within the reservoir during some winters. In the last half-dozen years, ice formation has been limited; warming trends associated with climate change might limit the future frequency, duration and extent of ice. Shore-fast ice, ice attached to the riverbank, can weaken riverbanks. When river stage drops, portions of a thick fringe of shore-fast ice, momentarily cantilevered from the bank, may collapse and pull bank material loose. This process might be repeated several times throughout the winter season. During breakup of large masses of surface ice, ice can gouge and abrade riverbanks with considerable force. It is not known whether ice breakup has a significant adverse effect on riverbank stability within the Box Canyon Reservoir. Near-shore brushy vegetation such as willow may reduce the erosive effects of both shore-fast ice and floating surface ice. At the same time, these types of ice may limit the extent of brushy vegetation by suppressing establishment or survival. Since ice formation does not happen every year, it is not likely that ice has a significant effect on the distribution of riparian vegetation in the reservoir.

Undertaking A Site Assessment

A number of questions describing the bank condition and causes of erosion need to be answered to do a site assessment for riverbank stabilization. For example:

- What soils occur at a site? How do the soils influence the riverbank erosion at the site? How do the soil characteristics influence the design of riverbank stabilization measures (such as drainage rates and cohesion)?
- What is the annual range in water surface level?
- What is the shape of the riverbed? Is the offshore slope steep or gentle?
- What is the shape of the riverbank? What is the shape of the riverbank upstream and downstream of proposed stabilization project? What would be a stable bank configuration?
- What are the causes of riverbank erosion? Is one mechanism of failure the primary reason the bank is eroding?
- What types of vegetation can be established and will persevere within different zones along the riverbank?
- What stabilization techniques can be employed at this site that provide stability but that also preserve, protect or enhance the environmental and aesthetic values of the river?

The following are a series of steps that should be followed in order to undertake a site assessment of a particular segment of eroding riverbank.

Location and River Mile

Locate the segment of riverbank under investigation on the appropriate maps in *Appendix 2 Location By River Mile*. Determine to the nearest mile the riverbank location relative to river mile (RM).

Ground Elevation

Establish a benchmark and determine the ground elevation for the project site using the following procedure (or have a surveyor provide a benchmark). Set a wooden stake in the ground at the water level on a given day (for safety reasons, don't do this during high flow!). Establish the ground elevation at the benchmark using the observed river discharge. First, on the internet, go to the USGS website and find the real-time discharge for the gage *12396500 Pend Oreille River near Ione, WA* for the day the stake was set. The gage information can be found at:

http://waterdata.usgs.gov/wa/nwis/uv?site_no=12396500

Refer to Table 2 in Chapter 2. Based on the river mile location of the project site and the discharge from the gage, determine the water elevation for the time when you set the stake.

Soil Type

Determine the soil type of the riverbank. Look at the exposed soils. Are they sandy or do they consist of finer silts and clays? Rub loose soil between your fingers. Is if gritty, or soft? Gritty reflects a sand content; soft reflects a silt and clay content. Soils high in silt and clay are susceptible to failure associated with internal seepage (from groundwater and rapid drawdown) and tend to become oversteepened from toe erosion, and then collapse. If a particular riverbank is high and steep, the soil and subsoil materials are likely high in silt and clay.

Internal Seepage

Look at the riverbank to determine if there is or has been seepage from within the riverbank. Seepage is commonly evidenced as bare areas from which small quantities of groundwater water has flowed; these are often associated with small, localized collapse failures (Figures 9A ad 9B). If the soils are sandy, it is not likely that internal seepage is a significant issue.

Figures 9A and 9B. Bank seepage through riverbanks consisting of silty loam and gravel, respectively.

Water Level Fluctuation

Determine the range of river water levels that can be expected at the project site (during mean, “wet” and “dry” years) from Figure 6 and the appropriate figure in *Appendix 1 Stage Variation*. Determine the elevations of these ranges, using the established ground elevation at the benchmark. Set stakes in the ground for the upper level of these extremes to represent seasonal high water levels. Set stakes within the area of the proposed project, as well as stakes corresponding to these elevations outside the project area (so that these reference stakes will not be disturbed during construction).

Riverbed Configuration

By wading or using a boat, determine the depth of river a given distance from the edge of the riverbank. Is the riverbed slope relatively steep (2:1 [Horizontal:Vertical] or steeper), moderate (between 2:1 and 4:1) or gentle (flatter than 4:1)? For example, if the water depth is 3 feet about 30 feet from the edge of water, the slope is 10:1 and is gentle.

Wave Action

Evaluate whether waves from wind and boats occur at the site. To the extent possible, describe the character of the waves (amount, season corresponding river stages, and wave heights), and estimate the effects of wave action on riverbank stability. Estimate whether the riverbed and associated aquatic vegetation dampers wave action.

Riverbank Configuration

Take measurements with a tape measure and or rod to determine the configuration of the existing bank. Draw cross-section (looking from a side view) and plan view (looking downwards from above) sketches depicting the average height and angle, as well as the locations of predominant changes in slope, locations of vegetation lines, extent and limits of erosion, trees to be saved, and buildings or other structures. As examples, Figure 10 and Figure 11 show a photo and cross-section sketch of a riverbank at about RM 73.5, and Figure 12 and show a photo and cross-section sketch of RM 80.3.

Figure 10. Photo of a bank along the Pend Oreille River at RM 73.5, corresponding to the dimensions shown in Figure 11.

Figure 11. Cross-section of the riverbank corresponding to Figure 10.

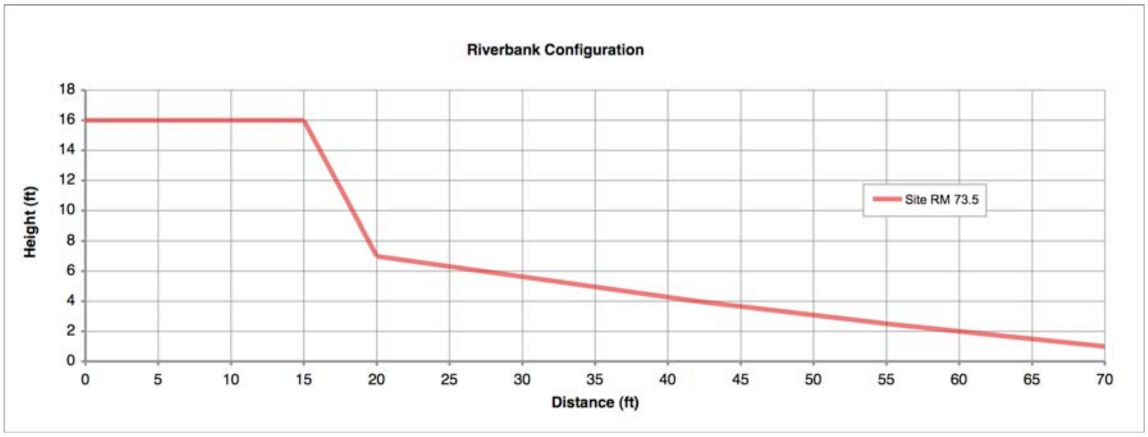
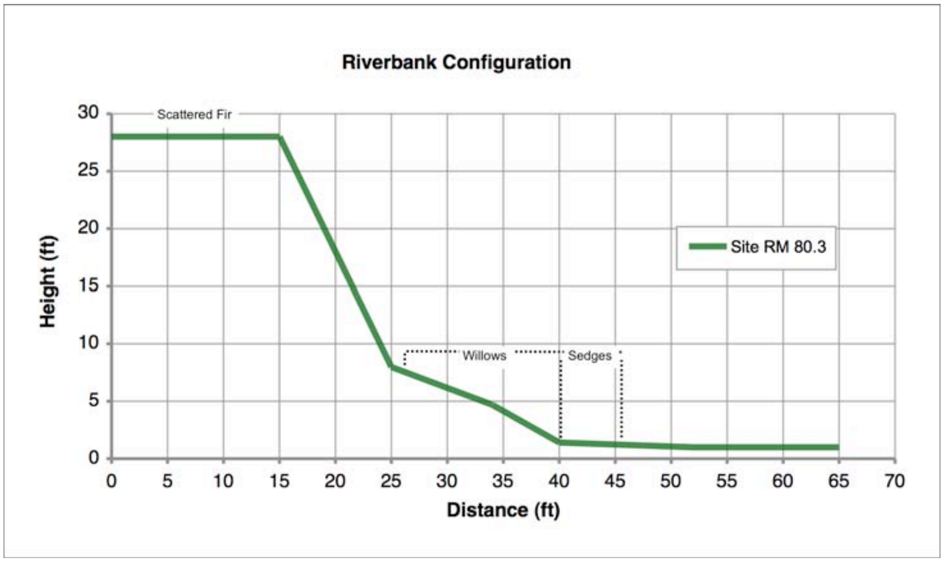


Figure 12. Photo of a bank along the Pend Oreille River at RM 80.3, corresponding to dimensions shown in Figure 13.

Observe the riverbank configuration upstream and downstream from the proposed project. How do these conditions differ, if any, from those within the project site? Consider how the proposed bank stabilization measures will need to transition into the adjacent riverbank. If erosion is occurring beyond the limits of a single property, consider undertaking a project collectively with the landowners affected by the erosion; comprehensive stabilization projects are typically more successful that those constrained by property boundaries (the process of erosion does not tend to respect property lines!).

Figure 13. Cross-section of the riverbank corresponding to Figure 12.



Determine Causes of Erosion

Using the information provided in this chapter, determine the causes of erosion of the riverbank. Determine all potential causes, and identify the one or two causes that seem to be driving the problem. Determine those causes of erosion that will need to be reduced in order to design a successful bank stabilization measure. Attempt to estimate the rate of erosion (for example, how much erosion occurs every year). A vertical riverbank entirely lacking vegetation on the slope likely indicates active and ongoing erosion Figure 14. Conversely, if there is woody vegetation growing on the slope or at the toe of a riverbank, the bank may now be generally stable (Figure 15), even if there is evidence of previous erosion. Such vegetation often indicates that erosion may have occurred some time ago, but is no longer active.

Figure 14. Actively eroding riverbank.

Figure 15. Riverbank with established alder, fir and herbaceous vegetation on the slope and sedge at the bank toe.

4. Considering a Solution

Introduction

This section links the site and reach assessments described in the previous sections with the environmental and engineering considerations involved in risk assessment, establishment of design criteria and environmental mitigation. A "checklist" is provided to guide landowners through the process of evaluation and selection of an appropriate method of riverbank stabilization.

Risk and Cost Considerations

Types of Risk

Assessing risk is a highly subjective yet critical process in evaluating bank erosion and considering bank stabilization. Risk is the product of consequence and probability. A high-risk situation is one in which the probability and/or the consequence of failure is high. A lower-risk situation is when the probability of occurrence or the nature of the outcome is less severe. Determining the nature and degree of risk depends upon the point of view of those who have a stake in the outcome. For instance, weighing risks to habitat, property and safety against each other will likely result in differing conclusions, depending upon whether one is a property owner, a recreationist or a resource manager. Assessment should always weigh the risks of bank stabilization as well as the risks of bank erosion.

The selection of riverbank treatment is often guided by the assessed risk of failure. The use of "soft" bank stabilization techniques, such as revegetation alone, can be used if either the probability or consequence of continued bank failure is low. In their early stages, purely vegetative bank stabilization techniques often provide less guarantee of protection than more structural techniques. However, they can act as a buffer initially, and they provide secure protection once vegetation becomes established and bank strength is restored. An eroding bank is not usually a risk to habitat. Erosion is a natural process that can recruit large woody debris for a healthy river and riparian ecosystem.

Cost for Bank Stabilization

Cost considerations for both bank erosion and bank stabilization should include:

- Repair of damage to property and infrastructure;
- Relocation of at-risk facilities (such as roads, homes and out-buildings);
- Compliance with legal requirements for habitat rehabilitation;
- Restoration of the riverbank to prevent further habitat losses associated with a bank stabilization project;
- Design, construction and maintenance of the bank stabilization measure; and
- Habitat mitigation for the duration of the impact, including any required monitoring and mitigation adjustments.

Design Criteria

Design criteria are specific, measurable attributes of project components developed to meet objectives. Put more simply, they describe how a successful outcome would function if the objective were met. While an objective might be stated in general terms, such as “minimize erosion” and “maximize stability during high flood events,” design criteria are more specific; they describe what it means to meet the objective. For example, a bank stability design criterion might state “stone armor will be installed to the annual mean water level during June.” Design criteria are target standards or performance measures set for individual components of a design, providing numeric, allowable limits of performance and tolerance for bank stabilization components and environmental features. These performance measures relate to reversing, preventing or minimizing the mechanisms of failure described in Chapters 2 and 3.

When applied in conjunction with design analysis, design criteria might answer questions such as:

- What type of ground-surface protection is appropriate, if any?
- How big should the toe foundation material be, and how deep should it be placed beneath the existing riverbed?
- What specific mitigation features will be required?
- What type of erosion-control fabric, if any, should be used on the upper bank, and how should it be installed?
- What trees and shrubs should be used for revegetation; how large should they be when planted, and how should they be cared for?

The number and focus of design criteria for any given project depend upon the scale and extent of the particular project itself. Simple, uncomplicated projects with little ecological effect may require only a few design criteria, whereas more complex or risky projects may require a more extensive suite of criteria.

Habitat Impacts

It is important to understand the specific potential impacts that bank stabilization treatments have on river function and fish habitat. Without this level of understanding, treatments may be selected that have unintended but severe consequences to the ability of the river to support aquatic life. There are three types of impacts associated with bank stabilization projects within the Box Canyon Reservoir, as described below.

1. *Construction Activity Impacts*. Construction-activity impacts to the riparian corridor and the riverbed can often be avoided. Construction activity that causes impacts is often short-term, though impacts to a mature riparian area may take decades or centuries to recover. Short-term impacts can usually be addressed and minimized by construction timing and sequencing, water quality protection techniques, work-site isolation, revegetation, and erosion- and sediment-control practices. Long-term construction impacts are caused when riparian vegetation is removed along the bank or in the water, when soil is compacted, when surface drainage is changed or when heavy equipment is repeatedly used for maintenance. Impacts include tree removal, erosion of bank and disturbed soils, release of sediment to the water, road construction, soil compaction, channel and bank reconfiguration and debris removal. Construction impacts must be mitigated

at the time of project construction. Mitigation is usually covered with standard Hydraulic Project Approval permit provisions.

2. *Direct Loss of Habitat*. Direct habitat loss is the immediate and permanent alteration of habitat by a project. It is also the lost ability of a site to naturally restore the habitat functions associated with it. Direct loss of habitat may include loss of wildlife habitat, shade and woody material recruitment, variable shoreline margins for use by juvenile fish, individual pieces or accumulations of debris, and riparian function.

3. *Increased Risk Resulting from Perceived Protection*. Riverbank stabilization treatments often create a false perception that properties adjacent to the river are now safe from erosion. This false sense of security can provide a sense of confidence to increase land development, which in turn may increase the risk associated with future bank erosion. Special care should be taken in land development planning and riverbank management to account for such a risk.

Those considering implementation of riverbank stabilization measures should review *Chapter 4 Considerations for a Solutions in the Integrated Streambank Protection Guidelines* (ISPG)[1] for a more thorough discussion of risk assessment and mitigation procedures.

Landowner Checklist

This section summarizes the evaluation and design process that can be undertaken by landowners for most riverbank stabilization projects along the Pend Oreille River through Box Canyon Reservoir. A landowner "checklist" is provided to guide this process. The checklist is compiled from the preceding sections of this document; more detailed discussions of the checklist points can be found by referring back to the reach and site assessments in Chapters 2 and 3, respectively.

The landowner checklist, described below, is summarized in Table 3.

1) *Risk*. Characterize the level of risk. Are buildings threatened? Is land likely to be lost to erosion? Has the erosion resulted in a steep, unsafe riverbank? These are all conditions with varying levels of risk.

2) *Location and Ground Elevation*. Find the location (by river mile) of the proposed riverbank stabilization project using maps in *Appendix 2 Location By River Mile*. Set a benchmark (such as a wooden stake driven into the ground). Establish the ground elevation at the benchmark, using the observed river discharge (from the USGS gage near Ione) at a given date and the calculated water elevation for that flow at the determined river mile location (from Table 2 in Chapter 2).

3) *Soil Type*. Determine the soil type of the riverbank. Look at the exposed soils. Are they sandy or do they consist of finer silts and clays? Soils high in silt and clay are susceptible to failure associated with internal seepage (from groundwater and rapid drawdown) exhibited as slumping. Vertical riverbanks likely indicate soils high in silt and clay. Sandy soils typically exhibit bank slopes with a flatter gradient.

[1] Cramer, M., K. Bates, D.E. Miller, K. Boyd, L. Fotherby, P. Skidmore, and T. Hoitsma.. 2002. Integrated Streambank Protection Guidelines. Washington State Aquatic Habitat Guidelines Program. Olympia, WA. Available at http://www.wdfw.wa.gov/hab/ahg/ispgdoc.htm.

4) *Internal Seepage*. Look at the riverbank to determine if there is or has been seepage from within the riverbank. Seepage is commonly evidenced as bare areas from which water has flowed, associated with small, localized collapse failures. If the soils are sandy, it is not likely that internal seepage is a significant issue.

5) *Water Level Fluctuation*. Determine the range of water levels that can be expected at the project site (mean, "wet" and "dry" years). Determine the elevations of these ranges, using the established ground elevation and the calculated river stage variations.

6) *Riverbed Configuration*. Determine the depth of river some distance from the edge of the riverbank. Is the riverbed slope relatively steep (2:1 [H:V] or steeper), moderate (between 2:1 and 4:1) or gentle (flatter than 4:1)?

7) *Riverbank Configuration*. Determine existing bank height and angle.

8) *Wave Action*. Evaluate whether waves from wind and boats occur at the site, describe the character of the waves (amount, season corresponding river stages, and wave heights), and estimate the effects of wave action on riverbank stability. Estimate whether the riverbed and associated aquatic vegetation dampers wave action.

9) *Determine Causes of Erosion*. Determine the causes of erosion that will need to be reduced in order to design a successful bank stabilization measure.

10) *Determine Applicable Bank Stabilization Techniques*. From Chapter 5, determine which generalized bank stabilization measures(s) are applicable to the site. Design one or more configurations that are appropriate for the site.

11) *Determine Materials Required for the Applicable Measures*. Determine the materials and quantities required to implement each of the bank stabilization measures that might be applied to the site.

12) *Estimate the Cost of Applicable Techniques*. Estimate the cost of materials and implementation of the applicable stabilization measures. Ask an earthwork contractor and/or revegetation specialist to assist with determining costs and to eventually provide a bid for the preferred alternative.

13) *Contact Washington Department of Fish and Wildlife.* Set up a site review with WDFW prior to submitting the permit application. Review with WDFW the information compiled and receive feedback from WDFW on applicable stabilization techniques for the site.

14) *Select Preferred Technique.* Select a preferred technique based on function, environmental benefit and cost.

15) *Submit Permit*. Complete and submit the Joint Aquatic Resource Permit Application (JARPA) to the WDFW with adequate time for permit acquisition before the desired construction period.

Table 3. Checklist outlining the process for design and permitting of riverbank stabilization projects along the Pend Oreille River within Box Canyon Reservoir.

Order		Activity	Description
☐	1	Risk	Characterize level of risk.
☐	2	Location and Ground Elevation	Determine the project location by river mile. Set a benchmark and determine the ground elevation at that point based on river flow and stage.
☐	3	Soil Type	Determine soil type.
☐	4	Internal Seepage	Determine if there is seepage from within the river bank (either seasonally or continuously).
☐	5	Water Level Fluctuation	Determine range of water surface changes (mean, "wet" and "dry" years) in feet and according to elevation.
☐	6	Riverbed Configuration	Determine the slope of the riverbed out from the bank.
☐	7	Riverbank Configuration	Determine existing bank height and angle.
☐	8	Wave Action	Evaluate the effects of wave action (amount, season corresponding river stages, and wave heights).
☐	9	Causes of Erosion	Determine the causes of erosion.
☐	10	Determine Applicable Bank Stabilization Techniques	Determine which generalized bank stabilization techniques are applicable to the site.
☐	11	Determine Materials Required of Applicable Techniques	Determine the materials and quantities required to implement each of the bank stabilization measures that might be applied to the site.
☐	12	Estimate Cost of Applicable Techniques	Estimate the cost to implement the applicable stabilization measures.
☐	13	Contact Washington Department of Fish and Wildlife	Undertake a site review prior to permit application with data compiled; receive feedback from WDFW.
☐	14	Select Preferred Technique	Select a preferred technique based on function, environmental benefit and cost.
☐	15	Submit Permit	Submit Joint Aquatic Resource Permit Application (JARPA). Submit application with sufficient advance timing in order to receive permits prior to desired construction period.

5. Bank Stabilization Measures

Have You Started with this Chapter?

Installation of bank stabilization measures can be a time consuming and expensive endeavor. Before a technique is selected, landowners should do their best to understand the conditions along their riverbank, the design process, and the benefits and limitations of various stabilization techniques. If you have started reading this guideline with this chapter, the authors recommend you return to the beginning and read this entire document before you consider bank stabilization options. You will find that Chapters 2 and 3 discuss reach and site assessment considerations, respectively, and Chapter 4 provides a framework and checklist to select a stabilization technique.

This chapter provides information on specific techniques that can be used for bank stabilization along the Pend Oreille River within the Box Canyon Reservoir. This chapter outlines five bank stabilization techniques that are appropriate for most riverbanks along the reservoir and have the support of WDFW. Landowners who submit HPA applications that appropriately utilize one or more of these techniques will be proposing measures endorsed by WDFW. These techniques are conceptual in nature; as such, landowners should conduct appropriate analysis and design for their particular site so that these techniques are properly applied.

Riverbank Stabilization Techniques

Vegetation along riverbanks plays an integral role in providing environmental attributes, fish and wildlife habitat and aesthetic values. While there are numerous examples of hard structural bank protection along the Pend Oreille River within the reservoir, there are few examples of integrated, bioengineered bank stabilization measures that fully incorporate plants as part of the structural component. Observations of natural conditions along the riverbanks, nonetheless, provide a basis for developing a framework for functional bioengineered bank stabilization measures which combine physical structure and vegetation. Based on these observations, the following conditions provide bank stabilization along the river:

- Maintaining and protecting existing riverbank vegetation;
- Promoting the establishment of dense vegetation (willow and sedge) on the low bench at the toe of the bank slope to minimize the effects of toe erosion and wave action;
- Restoring dense vegetative cover on the upper bank, preferably with woody species;
- Stabilizing the bank toe to resist toe erosion and undermining;
- Sloping the bank to a stable angle of repose; and
- Minimizing seepage from the bank.

These conditions formed the basis for developing a set of five bioengineered riverbank stabilization measures specifically applicable to the Pend Oreille River through the Box Canyon Reservoir. These five riverbank stabilization techniques are described in this chapter, and include:

- Technique 1. No Stabilization Action with Monitoring;
- Technique 2. Vegetation Establishment (Figure 16);
- Technique 3. Toe Armoring Without Bank Slope Reduction (Figure 17);
- Technique 4. Low Bench (With and Without Bank Slope Reduction)(Figure 18 and Figure 20); and
- Technique 5. Bioengineered Bank Stabilization (Figures 20 through 26).

The technique sections in this chapter include a textual discussion of the various elements, schematic drawings depicting these elements, a description of materials and (where possible) quantities, and estimates of unit costs. Since the dimensions of certain design elements will vary depending upon the location in the reservoir where the techniques are applied (due to river stage variation), a table with site-specific dimensions is provided (Table 4). Subsequent to the technique description sections, a materials section provides a discussion of the materials used in each of the techniques.

Many of the technique descriptions include some variation to a common element. The most notable variations include: 1) reducing (or not reducing) the slope of the eroding bank in conjunction with some stabilization techniques; and 2) the application of different soil bioengineering methods for ground surface stabilization.

Table 4. Guide for determining dimensions of certain components of bank stabilization techniques that are dependent on location within the reservoir (that is, dependent on seasonal variations in river water level).

Location	River Mile	Base Elevation A (ft)	Stone Elevation B (ft)	Maximum Stone Height B (ft)	Reconstructed Bank Elevation C (ft)	Reconstructed Bank Height C (ft)	Low Bench Elevation D (ft)	Low Bench Height D (ft)	Low Bench Width E (ft)
Ione	38.0	2029.0	2033.3	4.3	2035.0	6.0	2032.0	3.0	6
Tiger Slough	45.0	2029.0	2033.3	4.3	2036.3	7.3	2032.2	3.2	6
Blueslide	52.0	2029.0	2035.8	6.8	2038.2	9.2	2032.6	3.6	8
River Bend	60.0	2030.1	2038.3	8.2	2040.9	10.8	2033.5	3.4	8
Cusick	70.0	2030.3	2038.9	8.6	2041.9	11.6	2033.8	3.5	10
Dalkena	77.0	2030.4	2039.7	9.3	2043.8	13.4	2034.2	3.8	10
Marshall Cr	84.0	2030.7	2040.8	10.1	2045.6	14.9	2035.0	4.3	12
Newport	88.0	2030.9	2041.9	11.0	2046.9	16.0	2035.7	4.8	12

Technique 1. No Stabilization Action with Monitoring

Landowners should consider whether the best course of action might be to take no action. Upon evaluation of the causes of erosion, the rate of erosion, the risk to property and the cost for riverbank stabilization, landowners may feel that implementing stabilization measures is not justified. The site may be tending toward a stable condition, or the amount of erosion may be minimal. One benefit of going through the evaluation process is that landowners can use the collected information to monitor changes at the site from year to year. If no significant change occurs, then stabilization is unwarranted. If major changes are observed, then it may suggest that stabilization is appropriate.

Figure 16. Technique 2: Cross-section of toe protection using vegetation plantings and coir fabric.

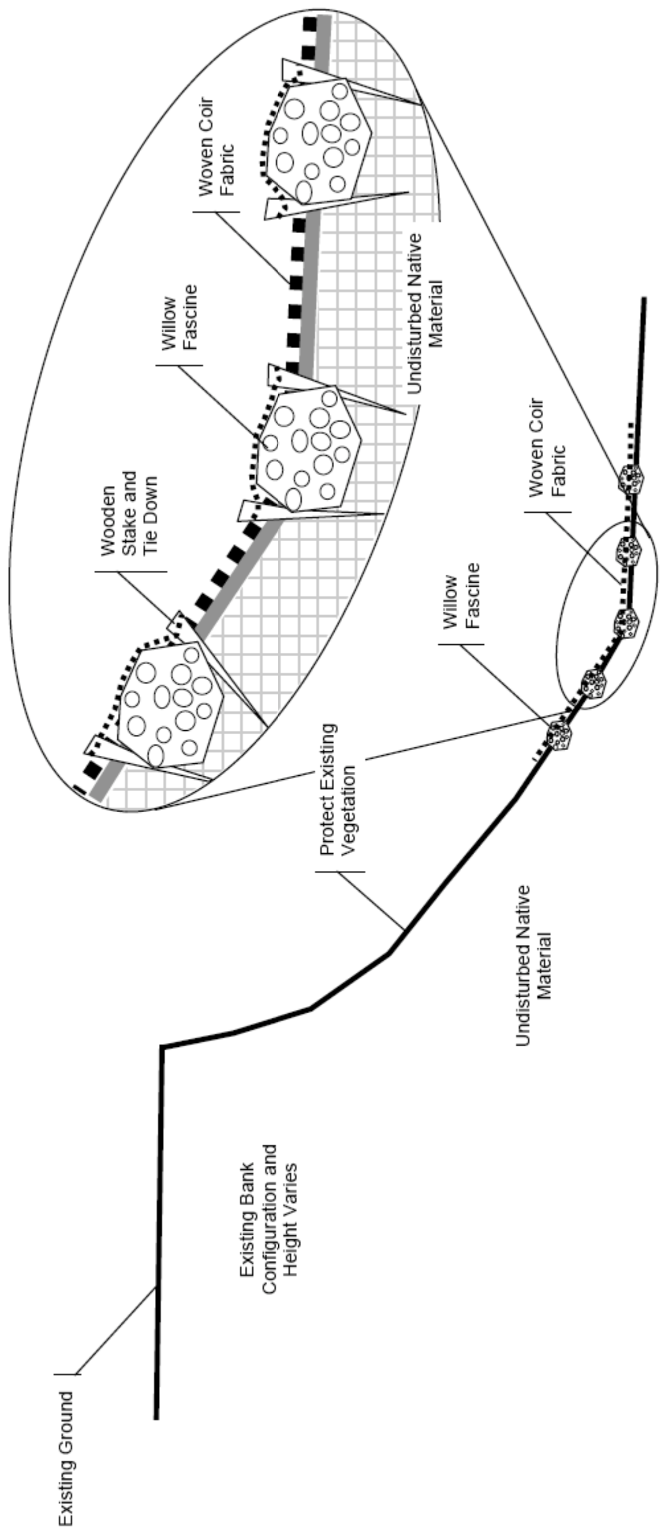


Figure 17. Technique 3: Cross-section of toe armoring without bank slope protection.

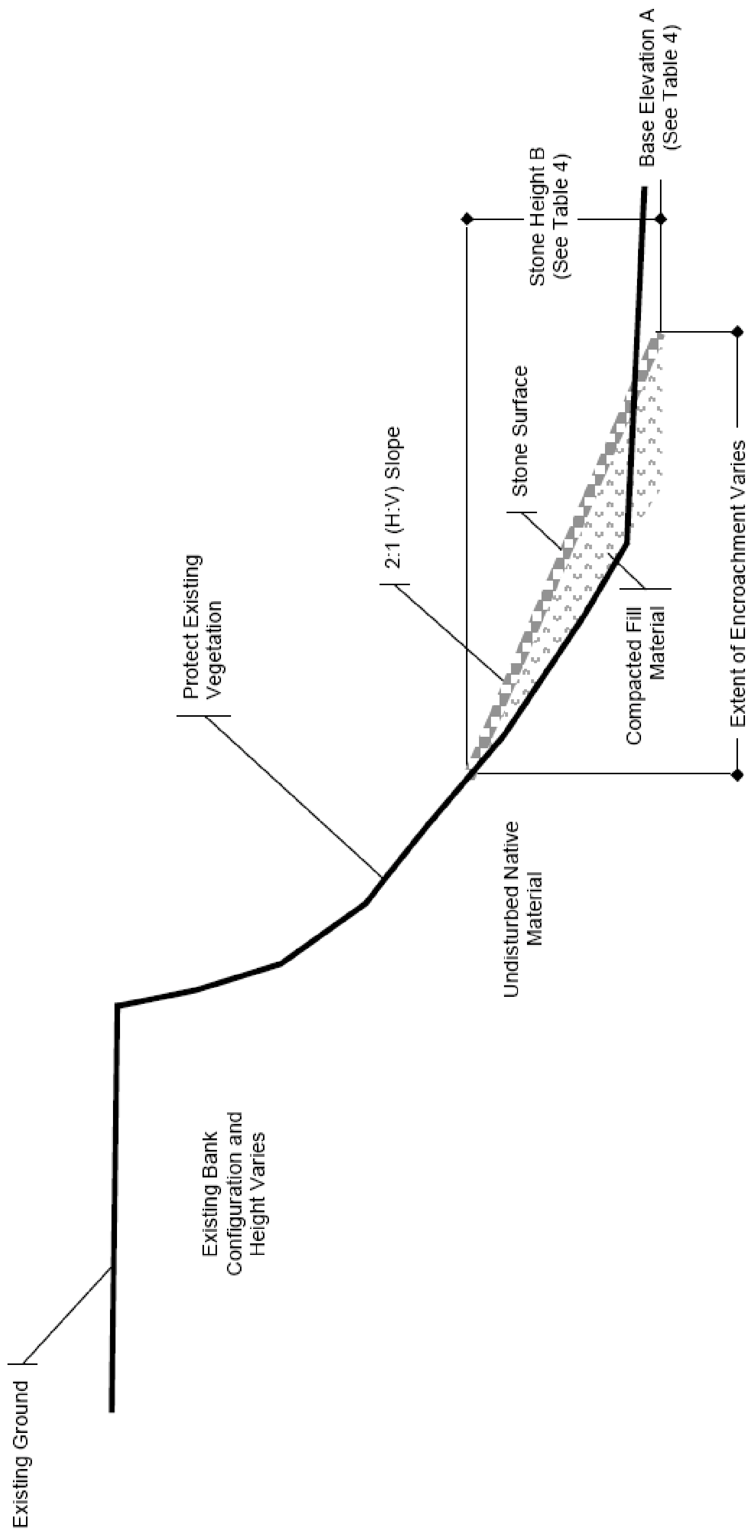


Figure 18. Technique 4: Cross-section of low bench with and without bank slope reduction.

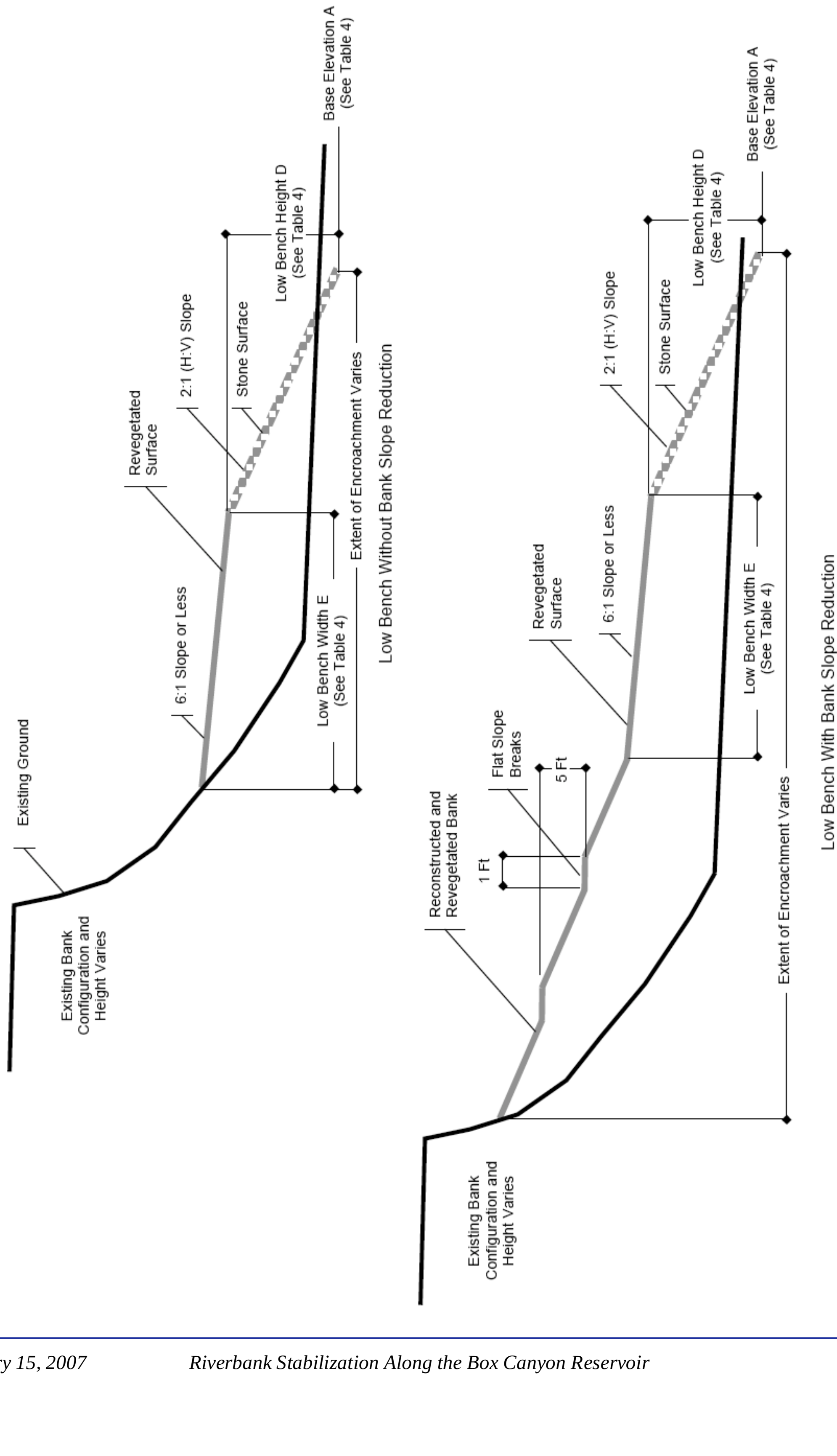


Figure 19. Technique 4: Details of low bench with variations in surface treatment.

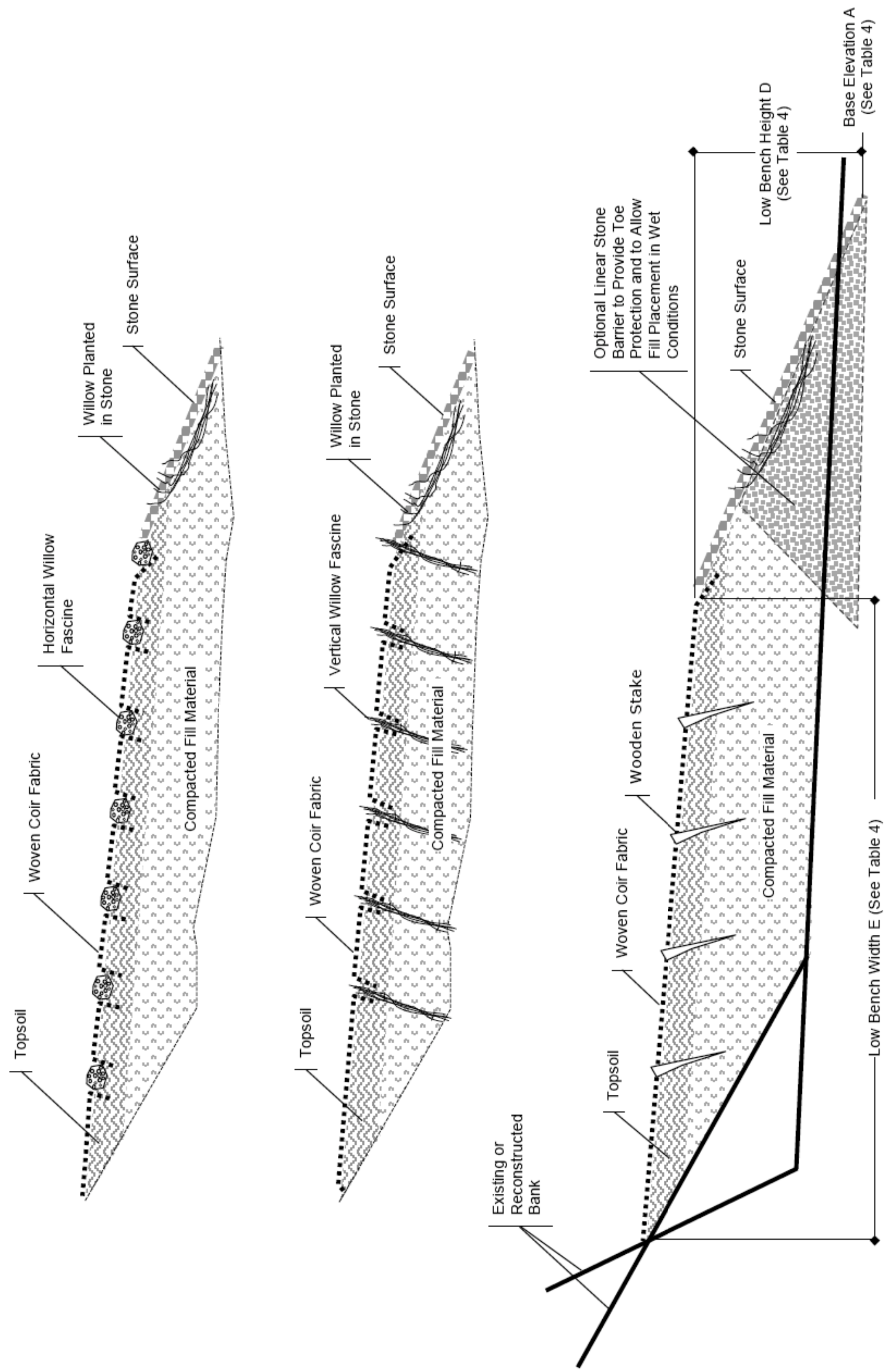


Figure 20. Technique 5: Generalized cross-section of bioengineered bank stabilization.

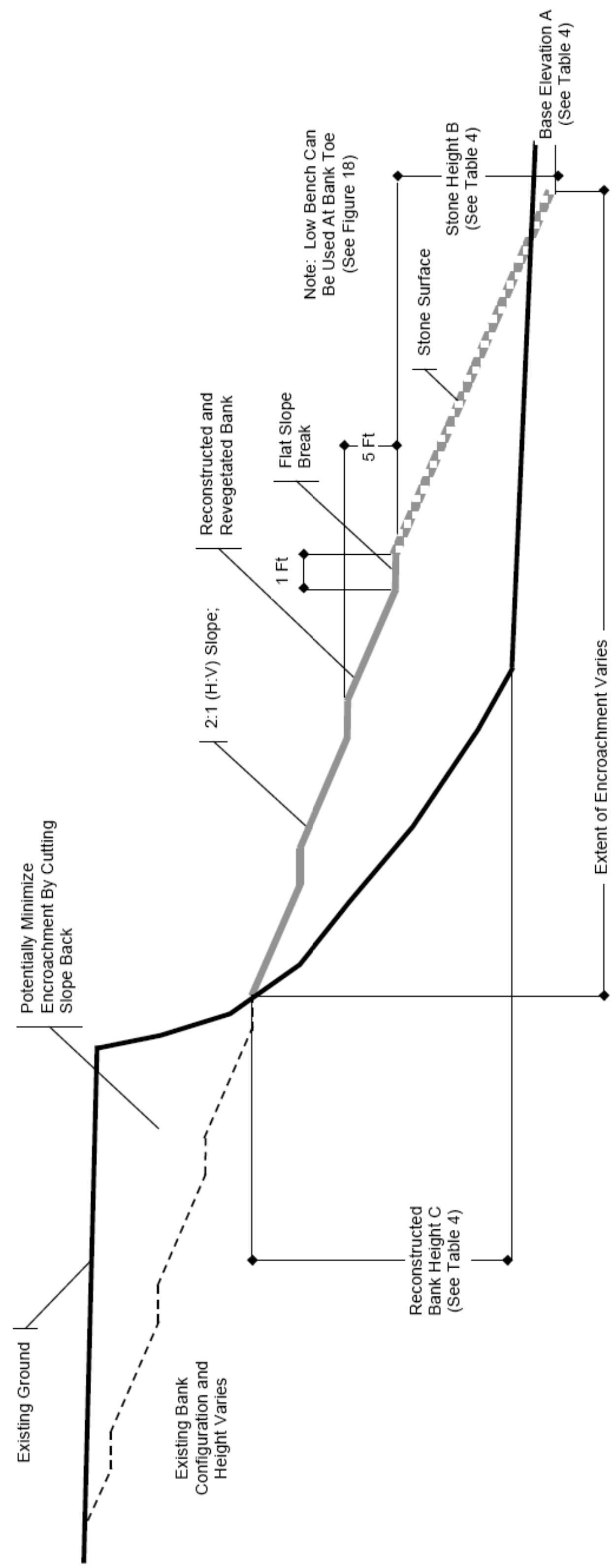


Figure 21. Technique 5: Bioengineered bank with variations of toe stabilization.

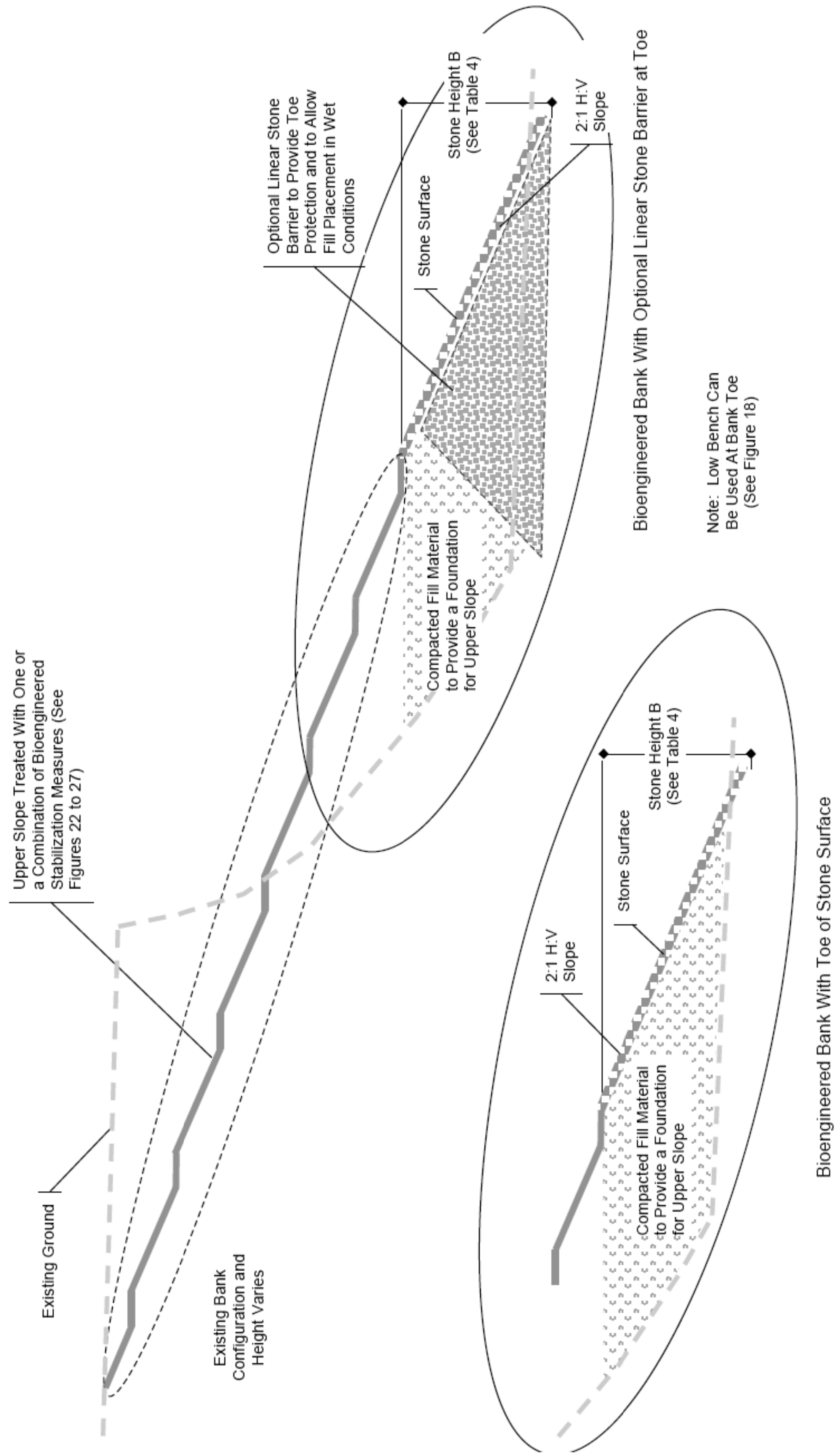


Figure 22. Technique 5: Bioengineered bank slope with willow fascines and coir fabric.

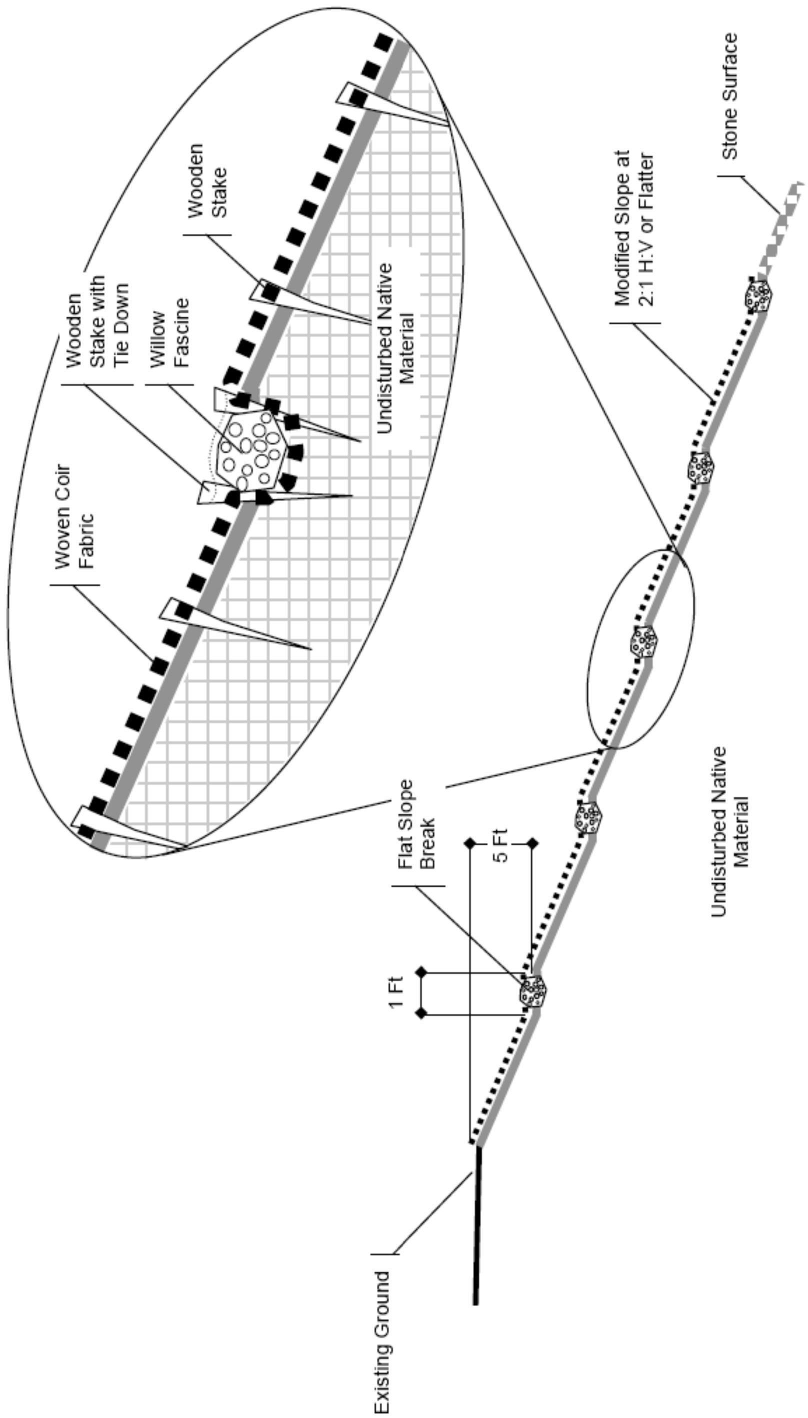


Figure 23. Technique 5: Bioengineered bank slope with willow brush bundles and coir fabric (with and without optional geogrid and gravel filter).

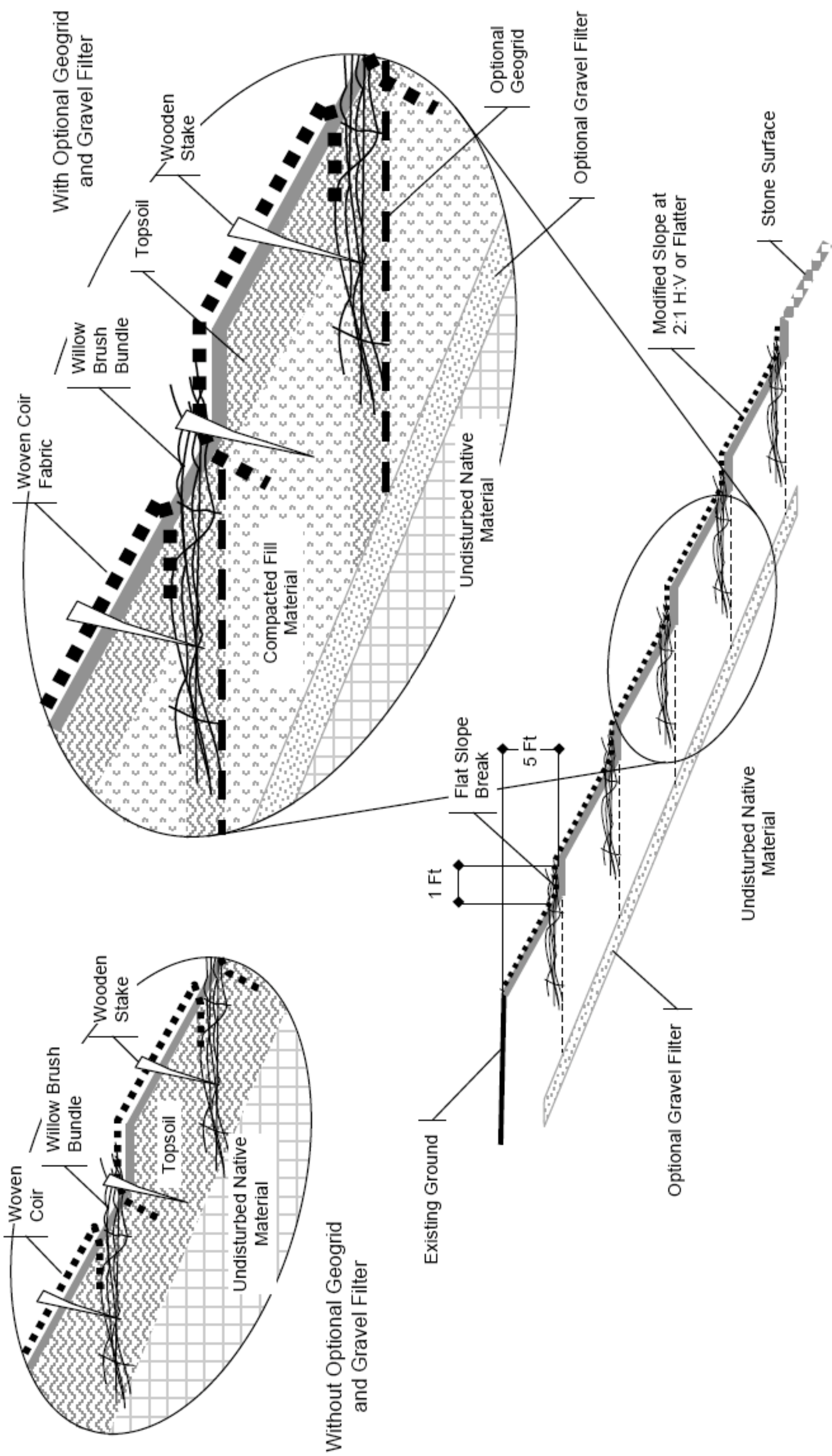


Figure 24. Technique 5: Bioengineered bank slope with vegetated geogrid (with and without optional gravel filter).

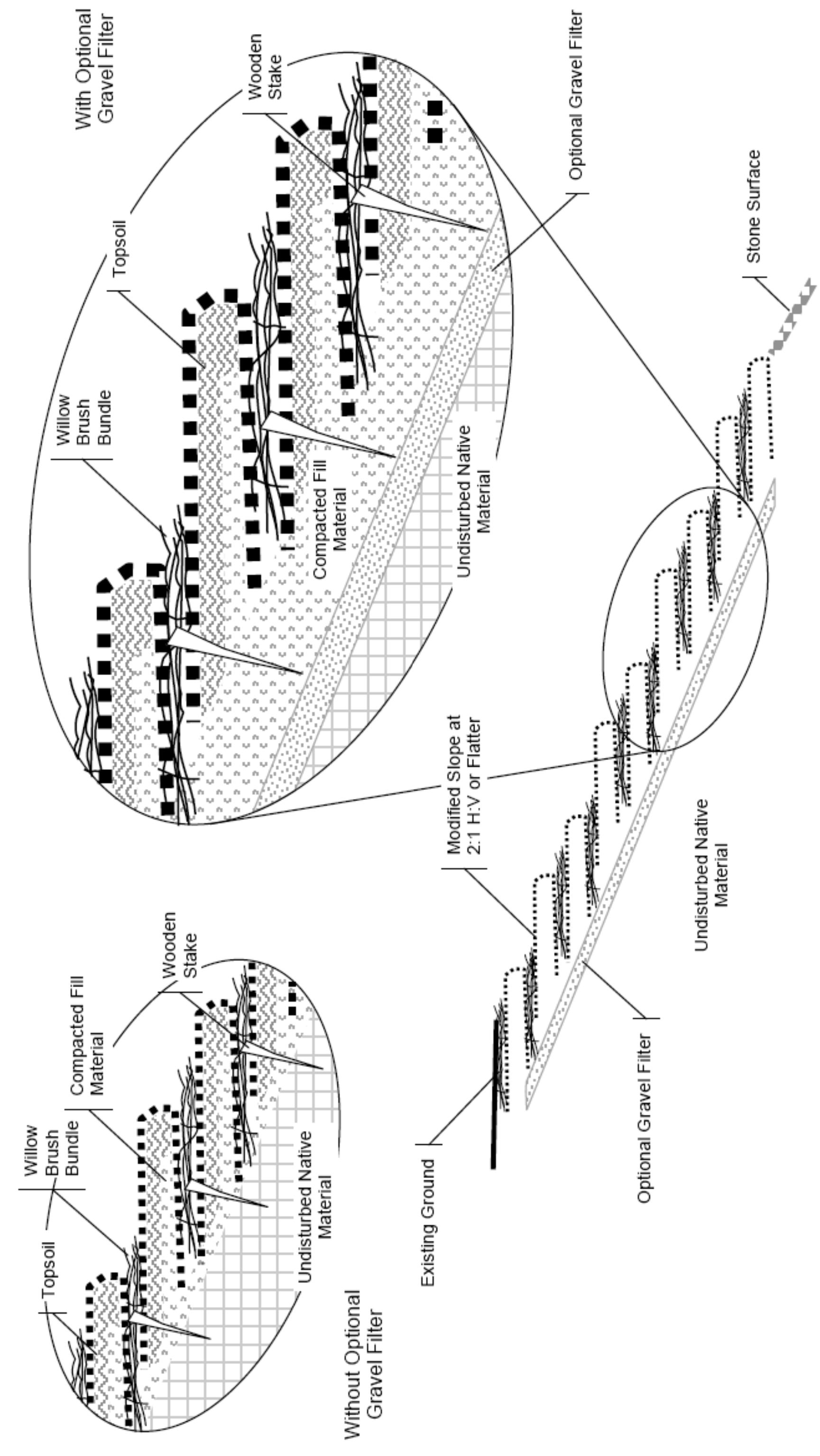


Figure 25. Technique 5: Bioengineered bank slope with geocell surface.

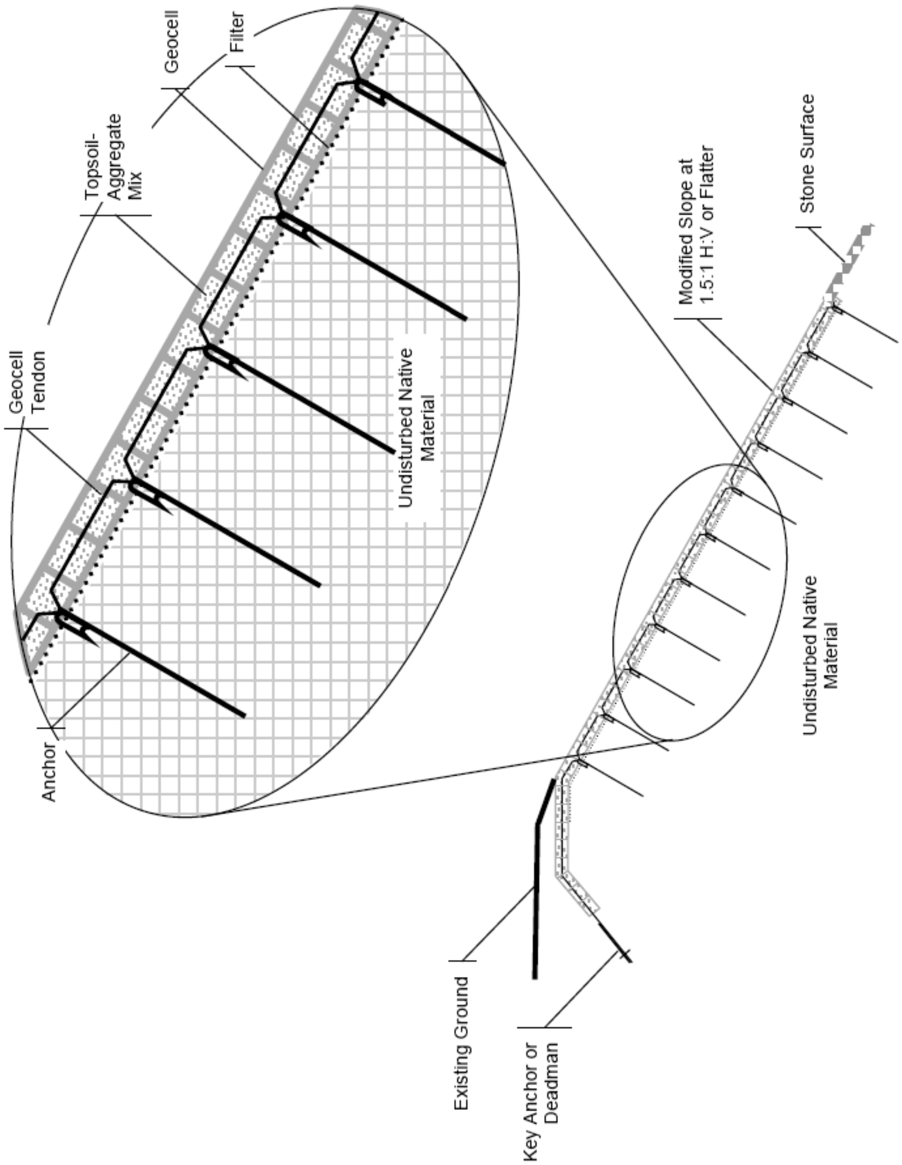
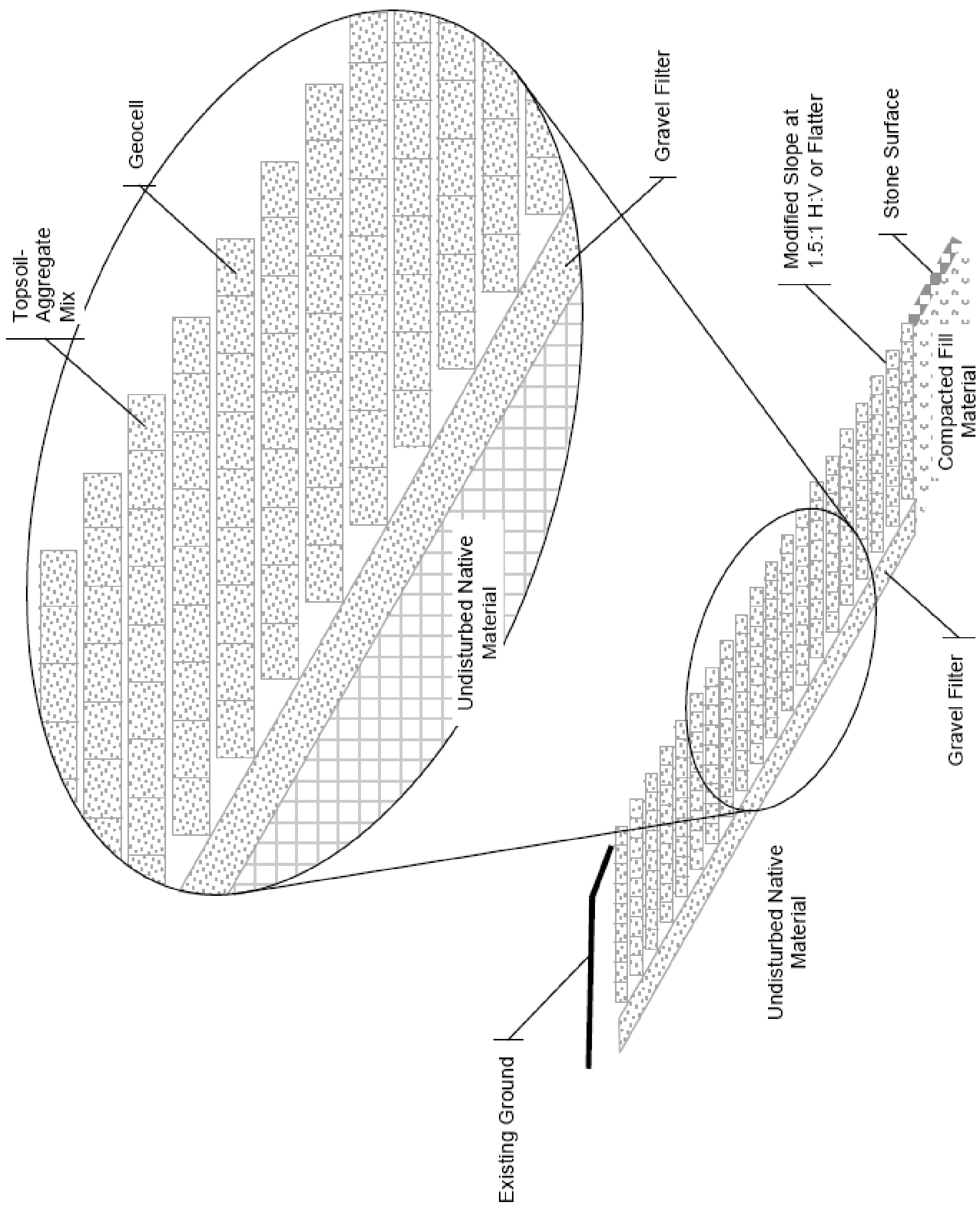


Figure 26. Technique 5: Bioengineered bank slope with stacked geocell.



Technique 2. Vegetation Establishment

Description

Technique 2 involves establishing vegetation at the toe of the existing riverbank without modifying the slope (Figure 16). This technique should be considered if the extent of erosion is limited and the risk to infrastructure is minimal. This technique is applicable if willows and sedges are growing at the base of adjacent reaches of riverbank, indicating that such plants can thrive in this setting.

Installation of this technique involves the following steps:

- Placement of willow fascines parallel to the bank at 3 to 6 foot intervals, with the fascines half buried in the substrate;
- Placement of coir erosion control fabric on the ground surface between the rows of fascines; and
- Staking at 3-foot intervals the fabric and fascines with wooden stakes and tying down the fascines between stakes with cord.

Materials

The materials required for this technique include:

- Willow fascines;
- Coir erosion control fabric; and
- Wooden stakes and cord.

The quantity of willow cuttings will depend on the number of rows of willow fascines. Assuming 4 rows of fascines are placed 3 feet apart along a 100-foot long riverbank, approximately 400-500 8-foot long willow cuttings and 150-200 square yards of fabric will be needed.

Estimated Cost

The cost to implement Technique 2 is low compared to the other alternatives. The cost to treat 100-feet of riverbank can range from a few hundred dollars to $2,000 depending on whether labor is provided by the landowner. If they desire, landowners can install this treatment without hiring a contractor; this technique can be implemented by hand without the need for heavy equipment.

Technique 3. Toe Armoring Without Bank Slope Reduction

Description

Technique 3 involves armoring the bank toe with stone, with minimal modification of the upper bank (Figure 17). This technique is applicable if shrubs and trees are growing on the upper bank and it is possible to install toe protection while preserving this vegetation.

Installation of this technique involves the following steps:

- Where needed, place compacted fill against existing slope as a base for stone;
- Place granular filter material; and

- Place stone fill.

The preferred slope for both the stone surface is 2:1 (H:V). A somewhat steeper slope (1.5:1 H:V) may be viable, although steeper slopes have greater risk of failure.

Materials

The materials required for this technique include:

- Compacted fill material;
- Granular filter material; and
- Stone.

The quantity of compacted fill material will depend on the configuration of the riverbank. The quantity of granular filter and stone will depend on the height to which the stone is placed on the bank. Assuming a 2:1 (H:V) bank slope, the quantity of granular fill and stone required for a 100-foot long riverbank is approximately 4 and 20 cubic yards, respectively, for every vertical foot of stone surface protection.

Estimated Cost

The cost to implement Technique 3 depends on the height of the stone surface protection. The cost to treat 100-feet of riverbank can range from $4,000 to $8,000 depending on the amount of rock required. Landowners will need to hire an earthwork contractor to implement Technique 3.

Technique 4. Low Bench With and Without Bank Slope Reduction

Description

Technique 4 involves constructing a low bench along the toe of the bank to create a protective vegetative barrier of grasses and willows. Two variations are presented. The first variation involves placement of the low bench adjacent to the existing eroding bank; the second involves placement of the low bench and reduction of the upper bank slope (Figure 18). The low bench is addressed in this section; reduction of the upper bank slope is addressed as part of Technique 5 Bioengineered Bank Stabilization. Several different variations of surface treatment of the low berm are presented (Figure 19); these involve different revegetation strategies.

The bench should have a gradually sloped surface (with a grade of 6:1 H:V or less) and should vary in width along the bank. The bench should have a gently undulating edge (as seen from a plan view) so that it is not straight and parallel to the bank line. Table 4 lists suggested height and width dimensions for the low bench.

The outer margin of the low bench can be treated with a surface layer of stone (and granular filter), although this may not be necessary and is at the discretion of the landowner. If construction the low bench involves encroachment into water (during low river flow), then as an initial construction sequence a linear stone barrier can be placed to segregate the construction area from the river (Figure 19).

The objective of Technique 4 is to establish dense growth of willow and sedge on the low bench surface. This can be achieved using seed, willow cuttings, willow fascines, and coir erosion control fabric (Figure 19). Revegetation measures for the low bench are the same as those used for Technique 5 Bioengineered Bank Stabilization. See the description of that technique for an explanation of revegetation measures applicable to the low bench.

Installation of this technique involves the following steps:

- If encroaching somewhat into flowing water, place a linear stone barrier at the location of the outer edge of the low bench;
- Place compacted fill to create the low bench (if using vertical willow fascines, install these as the bench is constructed);
- Place granular filter material and stone on the outer margin of the low bench (if a linear stone barrier is not used and if stone is desired);
- Place topsoil; and
- Place seed, willow fascines, coir erosion control fabric and stakes based on the revegetation measure selected.

Materials

The materials required for this technique include:

- Compacted fill material;
- Granular filter material (optional);
- Stone (optional); and
- Selected bioengineered materials (see Technique 5 Bioengineered Bank Stabilization).

The quantity of compacted fill material will depend on the configuration of the riverbank and the dimensions of the low bench. The quantity of granular filter and stone will depend on the height of the low bench and whether a linear stone barrier is used. The quantity of topsoil and revegetation materials will also depend on the dimensions of the low bench. Assuming a 3.5-foot high bench, an average of 10-feet wide, along a 100-foot long bank, the following approximate quantities would be required:

- 14 and 70 cubic yards of granular fill and stone, respectively;
- 20 and 120-150 cubic yards of topsoil and backfill, respectively;
- 120-150 square yards of erosion control fabric; and
- 500-1,000 8-foot long willow cuttings depending on the revegetation method used.

Estimated Cost

The cost to implement Technique 4 depends on the height and width of the low berm and whether a linear stone barrier, stone surface, or no stone is used. Earthwork costs will make up the bulk of the total project costs. Depending on ease of equipment and material access, the cost to construct a low bench along 100-feet of riverbank can range from $10,000 to $20,000. These estimates do not include the cost for associated bank slope reduction and bioengineered stabilization. Landowners will need to hire an earthwork contractor to implement Technique 4.

Technique 5. Bioengineered Bank Stabilization

Description

Technique 5 involves reducing the bank slope and stabilizing the bank with bioengineered stabilization measures (Figure 20 and Figure 21). Five variations of bioengineered bank stabilization are presented and are described in the subsequent subsections. The objective of Technique 5 is to establish dense growth of willow and grass on the bank. This can be achieved using seed, willow cuttings, willow fascines, coir erosion control fabric and geocells.

The riverbank should be sloped to 2:1 (H:V) or flatter. Bank treatments may be installed at a steeper slope if the materials used for stabilization allow. Table 4 lists suggested heights for the reconstructed bank relative to location within the reservoir. The toe of the bank can be treated with a variety of measures, including soil and vegetation, a stone surface, a linear stone barrier, or a low bench (as described in Technique 4 Low Bench With and Without Bank Slope Reduction). Intermittent slope breaks should be incorporated into the reconstructed riverbank. It is suggested that 1-foot wide benches be placed about every 5 vertical feet (or closer). These benches will serve to dissipate flow down the slope and will provide a location for vegetation to become established. They will also provide access and facilitate installation of surface treatments.

Installation of this technique involves the following steps:

- If constructing a low bench, follow the installation instructions for that technique (Technique 4).
- If encroaching somewhat into flowing water, place a linear stone barrier at the location of the outer edge of the bank;
- If needed, place compacted fill to build the bank (if using embedded willow fascines, install these as the bank is constructed) or grade the bank to the final slope;
- Place granular filter material and stone along the toe of the bank (if a linear stone barrier is not used and if stone is desired);
- Place bioengineered stabilization measures on the bank surface, which may include placing topsoil, seed, willow fascines, coir erosion control fabric, stakes or geocells, based on the measure selected.

Willow Fascines

Also called wattles or contour wattles, fascines are long bundles of live cuttings that are bound together and secured to the streambank or floodplain with live and dead stakes. They are commonly placed on the bank in multiple rows of shallow trenches that run parallel to the contour, although they can also be planted vertically. Bank stabilization is achieved by breaking up the bank into a series of smaller, vegetated slopes that dissipate energy, physically bind the soil within the root zone and promote the entrapment of sediment and debris. Installing erosion-control fabric between fascines can enhance the initial erosion-control capabilities of the system.

Plant materials for fascines should be 1/2 to 2 inches in diameter and at least 5 feet in length (the longer the better). The completed fascine should be eight to 10 inches in diameter and tapered at each end. For ease of handling, bundle length typically varies from 10 to 20 feet.

The recommended spacing between fascines varies with the slope and erosion resistance of the soil. Fascines oriented parallel to the soil surface are unable to reach the water tables at low flow; irrigation may be required until root systems become well developed. This method requires a relatively large amount of live plant material. It offers the advantage of providing immediate surface-erosion control.

Willow Brush Bundles

Placement of brush bundles consists of installing dense rows of live cuttings, branches and/or rooted stock between layers of compacted soil. Individual layers are generally aligned horizontally along the contour of the slope in small terraces 2- to 3-feet wide. Cuttings extend back into the bank and protrude slightly from the soil surface. As such, they immediately provide shallow soil reinforcement and protection from surface erosion, and they rapidly establish a vegetated riverbank. Bank stabilization is achieved by breaking up the bank into a series of smaller, vegetated slopes that dissipate energy, physically bind the soil within the root zone and promote the entrapment of sediment and debris. This technique is similar to placement of willow fascines because both involve placement of cuttings on slopes; the techniques differ in the orientation of the branches and depth they are placed in the slope. With brush bundles, cuttings are oriented perpendicular to slope contour. Brush bundles are particularly applicable in bank protection projects that require fill. They are less commonly used on eroded slopes where excavation is required to install the cuttings.

Individual brush layers should be 4- to 6-inches thick and comprised of rooted stock, branches, or cuttings 1/2- to 2-inches in diameter, and 3-feet minimum in length. Cuttings should be placed in a random, crisscross pattern (not parallel to each other) to maximize their contact with soil and, thus, their rooting capability. Recommended planting density varies from 2 to 6 branches per linear foot. As long as there is a sufficient percentage of live cuttings spread uniformly throughout the treatment, dead branches may be incorporated into the brush bundles. Recommended vertical spacing between brush bundles ranges from 3 to 6 feet, depending upon the erosion potential of the slope (i.e., soil type and length and slope of the bank). On long slopes, spacing should be closer at the bottom and decrease as one moves up the slope. Fill used between layers of branches must be able to support plant growth.

This method requires a relatively large number of live cuttings. It provides immediate, shallow soil reinforcement and surface-erosion control. If the layers of soil are wrapped with erosion-control fabric, brush layering works in a fashion similar to the vegetated geogrid technique (see the following discussion on this method). The addition of fabric to this technique adds relatively little to the cost, but greatly improves the erosional resistance, especially during the plant-establishment period.

Vegetated Geogrid

The term vegetated geogrid refers to a system of soil layers or lifts encapsulated or otherwise reinforced with a combination of natural or synthetic materials and vegetation. This system is also called fabric-encapsulated soil. The lifts are oriented along the face of a bank in a series of stepped terraces. When used with degradable fabrics, the fabric will provide two- to four-year erosion protection, giving installed vegetation the time it needs to become well established for long-term bank stabilization. In situations where increased strength and longevity are needed, synthetic fabrics can be used to provide both short- and long-term structural integrity.

This soil-reinforcement technique can be applied using a variety of fabrics and structural components. Numerous types of woven, non-woven, degradable and nondegradable fabrics can be used alone or in combination. Different fabrics provide varying levels of protection and longevity. Additionally, incorporation of geogrids and other geosynthetic materials within lifts can provide significant structural integrity. Soil reinforcement used in combination with gravel filters creates a workable solution where rapid drawdown and other drainage problems exist.

Geocell on Slope Surface

Geocellular containment systems can provide substantial structural support to the bank face, while allowing vegetation to establish almost unimpeded. On gently sloping banks, geocellular containment systems can be installed directly on the bank slope, at the same grade as the bank face. Geocell placed on a graded riverbank surface are anchored with internal tendons, anchors and deadman. A layer of granular filter material is often placed under the geocells; synthetic fabric should not be used for this purpose as it will inhibit root penetration.

The geocells should be filled with a mix of topsoil and granular filter material at a ratio of about 50-50. The topsoil will provide a growing medium for plants while the granular material will minimize erosion of the topsoil from within the cells. The fill should be seeded with an upland or wetland seed mix, as appropriate (see the following subsection on seeding). Stout willow cuttings (about 2-feet in length) can be driven into the ground through the cells after the geocell are installed on the ground surface.

Staked Geocell

Geocellular containment system can be installed on steeper banks using a stacked, layered or stair-step pattern for greater stability. To further increase slope stability where internal drainage is an issue, an internal drain of granular material and filter fabric can installed beneath the geocellular containment system. Stacked geocells do not require the level of staking when similar material is placed on a graded slope, because the layers of geocells provide stability. This method requires a stable foundation; such a foundation can be developed with compacted backfill or a subbase of rock.

Willow cuttings 3-5 feet in length can be laid horizontally between the layers of geocell as the lifts are installed. The geocells should be filled with a mix of topsoil and granular filter material at a ratio of about 50-50 and seeded.

Estimated Cost

The cost to implement Technique 5 depends on the quantity of earthwork required; as with Technique 4, earthwork costs will make up the bulk of the total project costs. Due to the variability in bank configurations and bioengineering treatments, the cost estimates for this technique have a wide range. The cost to re-slope or reconstruct a riverbank and to install bioengineered stabilization measures (not including construction of a low bench) along 100-feet of riverbank:

- Surface treatment with willow and erosion control fabric can be $5,000 and up;
- Embedded fascines and brush bundles with erosion control fabric can be $10,000 and up;

- Surface treatment with geocells can exceed $10,000; and
- Treatment with stacked geocells can exceed $20,000.

General Material Descriptions

The following sections provide descriptions of materials used in the various riverbank stabilization techniques.

Stone

Stone Surface

Stone should consist of angular or rounded stone. Stone with an average diameter of 6 to 8 inches appears appropriate for the Pend Oreille River through the reservoir. A well-graded stone mixture should be used, meaning that the stone should range in size from about 3 to 4 inches up to 12 to 16 inches. The stone should be paced at a thickness of about twice the average stone diameter, or about 12 to 16 inches thick. Optimally, stone should be placed at slope of 2:1 (Horizontal:Vertical) or flatter. Stone should not be placed at a slope steeper than 1.5:1 (H:V). Stone should be placed to a depth of a foot or so below the existing riverbed at the toe of the slope. Table 4 lists suggested elevations for the base of the stone toe relative to the site location within the reservoir.

Granular Filter

If the stone is placed over native silt and clay, a layer of granular filter material should be installed between the soil and the stone to prevent soil piping. A granular filter should consist of a graded mixture with an average diameter of ¾-inch stone placed to a thickness of 3 to 6 inches beneath the stone. If larger stone is used for surface protection, then the granular filter should be increased in size accordingly. Synthetic geotextile fabric should not be used as a filter under stone, as such fabric restricts the eventual establishment of woody species (such as willow) through the stone.

Linear Stone Barrier

If the toe of the reconstructed slope or low bench is built in wet conditions, a linear stone barrier might need to be constructed in order to provide a foundation against which the remainder of the slope or bench can be constructed. A linear stone barrier can be used to allow controlled placement of fill material in wet conditions without impacting water quality in the river.

Compacted Fill Material

If fill material is placed to build the slope outwards, it should consist of materials that can be compacted and provide suitable rooting medium. Either native material or a pit run material with at least 30% fines should be used. Pure clay or silt subsoil is not suitable material for compacted backfill.

Topsoil

Topsoil should be native or imported soil that consists of a sandy loam with a high degree of fertility. Without good topsoil, grass and shrubs planted to provide bank stability will not grow into dense, healthy stands. Subsoil high in clay or silt used in place of topsoil is a poor growing medium, and will result in bare areas prone to continued erosion. About

6 inches of topsoil should be incorporated into all growing surfaces in riverbank stabilization measures.

Erosion Control Fabric

Biodegradable erosion control fabric is used to temporarily stabilize the soil surface until plants (grasses and shrubs) become established and provide surface protection. In an order of increasing strength or resiliency, types of biodegradable erosion control fabric include those made of straw, wood fiber, jute, and coir. Straw, jute and wood fiber are good for uplands, but are generally not durable enough for use on riverbanks. In contrast, woven coir fabric is extremely durable (Figure 27). It is available in a variety of weights; coir fabric with 700 gram/m^2 weight is ideal for use riverbanks. Non-woven coir fabric (held together by plastic or jute netting) is less durable and is not suitable for riverbank stabilization.

Figure 27. Woven coir erosion control fabric, with willow cuttings and wooden stakes fabricated from 2 x 4 dimension lumber.

Wooden Stake and Tie-downs

The best stakes to use to secure erosion control fabric on riverbanks are 18- to 24-inch-long, wedge-shaped stakes made by cutting 2 x 4s diagonally (Figure 27). Narrow enough at the base to fit through woven coir fabric strands and wider at the top, these stakes pull fabric tightly as they are driven deeper, drastically reducing the chance of fabric lifting off the top. Stakes should be installed on 3-foot centers and key trenches should be placed at the top of slopes.

Metal stakes of any sort (including 6- to 8-inch metal "U" staples), commonly available from fabric suppliers, should not be used for riverbank protection; they do not securely hold fabric to the ground. Wooden stakes, often stocked by local lumberyards, may be appropriate in some instances; however, they also may not secure fabric tightly to the ground, and the fabric might easily lift off of straight stakes.

Where wooden stakes are used to secure willow fascines or bundles, biodegradable cord (made from an organic material such as coir, sisal, jute or hemp) should be used as tie-downs to secure the willows in place.

Geogrid

Geogrids are grids made of a UV-stable, high-strength, synthetic material (Figure 28). Geogrids were originally developed for use as an internal-stabilization tool for embankments, where the geogrid is laid horizontally in the fill materials to protect against translational and rotational slope failure.

Geogrids are also used to impart tensile strength to the surface of constructed riverbanks. In this way, geogrid is used to encapsulate soil and/or rock on the bank surface (this technique is termed vegetated geogrids). Geogrid offers a very durable and high-strength skin to the constructed bank. Its porous construction also allows vegetation to become established. Because the holes in geogrid are relatively large, an inner layer of fabric or reinforcement mat is often used in vegetated geogrids to prevent soil loss.

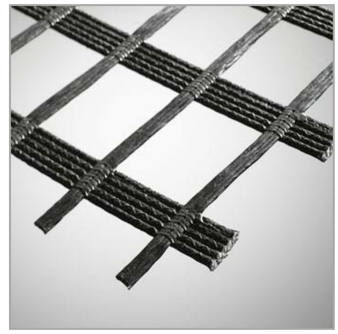


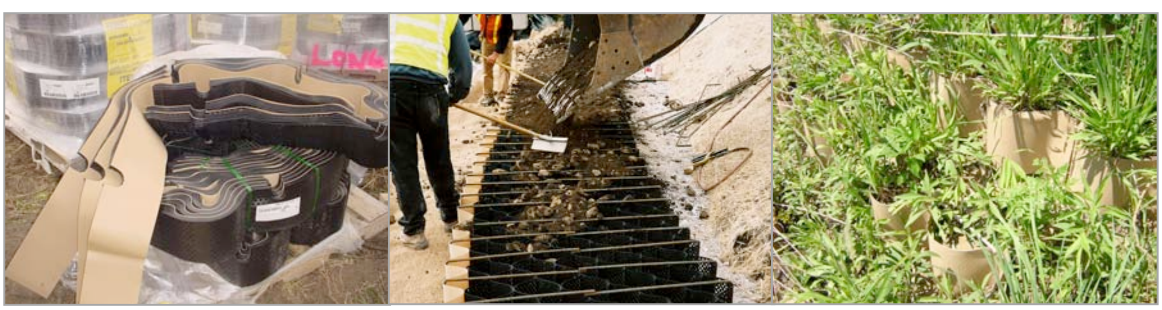
Figure 28. One type of geogrid.

Geocells, Tendons and Anchors

Geocellular containment systems are honeycomb-like cellular materials that stabilize the upper layer of soil, while allowing installation of soil and vegetation. Usually manufactured of polyethylene or polyester strips, the thin-walled cells are typically about 8 inches deep. Because the walls of the geocellular “honeycomb” are relatively thin, vegetation and soil make up the vast majority of geocell volume.

Geocells placed on the surface of a riverbank typically require some form of anchoring system. Geocell manufacturers provide a system of internal tendons and anchors can be driven or screwed into the soil. The driven style is set by providing tension on the anchor. The tension causes the deployment of legs or plates, which actually provide the anchorage. Deadman anchors are commonly used along the top of the bank. A deadman is a common form of anchor using a wide array of potential materials. The concept of a deadman is to bury an anchor in the bank that pushes against a wedge of undisturbed soil when tensioned.

Figure 29. Photos of packaged geocell, geocells being placed, and installed geocells.



Seed

Seed should be spread under all erosion control fabric before the fabric is installed (seed placed over the erosion control fabric has a low survival rate). Seed should be spread over all disturbed areas. Seed should be spread in subsequent years where revegetation success is limited and the ground remains bare. Upland seed should be used where site conditions are dry. Wetland seed should be used where soil moisture is higher. A rake should be used to cover the seed with ¼ to 1/8 of good topsoil to ensure good soil contact. Compacted soils (from foot traffic or heavy equipment) should be uniformly loosed to a depth of 6 inches before seed is applied. A thin layer of mulch (such as straw or compost) can be placed over the seed (and under erosion control fabric).

Sedges and Rushes

Sedges and rushes are highly desirable streamside plants because they stabilize riverbanks and are adapted to fluctuating water levels. The roots of these plants bind soil particles together in a cohesive unit, while the above-ground shoots and stems form a continuous soil cover that reduces velocities and erosional forces at the soil/water interface. Direct seeding of sedges and rushes can be ineffective; the best means of establishing these plants is by installing nursery-grown plants as small containers or plugs or transplanting wild plugs collected at or near the project site.

Willows

Willow cuttings consist of harvested stems of dormant willow shrubs. They are capable of developing both roots and shoots if planted in proper conditions. For the best chance of success, willow cuttings should be harvested during the dormant season, preferably fall or spring, and planted within days of collection. Willows are the most commonly used and most successful type of cuttings used for riverbank revegetation. Red-osier dogwood can also be used with good success in Washington. Few other riparian shrubs or trees native to Washington reliably and consistently root from cuttings. Cuttings are popular in bank-stabilization projects because they are inexpensive and can be collected in long lengths capable of accessing deep (10- to 12-foot) water tables. Whether installed as live stakes, fascines, or brush mattresses, cuttings provide excellent erosion control and bank stabilization. The following are some general guidelines for harvesting and planting cuttings:

- Planted willow cuttings have the highest survival when cuttings are taken from dormant plants (in the late fall and winter), but anecdotal reports suggest that successful establishment is sometimes possible from cuttings planted in early summer and early fall, especially if leaves and branches are stripped from the plants and cuttings reach the water table or are irrigated.
- Collect cuttings from healthy vigorous stock. One- or two-year-old wood is generally better than older wood, and cuttings taken from the center and bottom of the plant will frequently root better than those taken from the outside edges.
- Cuttings should be at least ½-inch in diameter. The length of the cuttings will depend on how they are used, whether they are installed as fascines or brush bundles or as individual cuttings.
- When harvesting cuttings, mark the base of each cutting with a clean, diagonal cut, and make sure the base of each cutting is inserted into the ground. Upside-down cuttings rarely survive.
- Cuttings should be kept moist, relatively cool and shaded until planting. Even on a cold day, exposure to direct sunlight will stress them. Soaking cuttings (at least that portion of the cutting that will be underground) in water for 24 hours or more prior to planting improves survival. Soaking is also an excellent, temporary, on-

site storage method. Water should be changed daily. Cuttings will be most successful if harvested and planted in the same day.

- If cuttings cannot be installed within days of collection, they can be held in long-term storage (up to several months) under cool, damp, dark conditions (refrigeration).
- Never plant cuttings into dry soils. If the site is not irrigated, the bottom of the cutting must reach a depth where the soil is permanently damp.

Example Application of Riverbank Stabilization Guidelines

In this section, a pair of recently completed, adjacent bank stabilization projects will be used to demonstrate how the landowner checklist is used and how bank stabilization measures are selected. The example site consists of a 600-foot long reach of left riverbank at RM 45.3 (Figure 30). The two projects were implemented in 2004 and the late 1990s. Prior to the work, the site consisted of a severely eroding bank with near-vertical slopes averaging 10-feet high (Figure 31). This reach of riverbank was devoid of woody vegetation.

Figure 30. A 2005 aerial view of the project site (after installation of bank stabilization measures).

Figure 31. Riverbank conditions prior to implementation of the 2004 stabilization project.

Stabilization Project

The downstream stabilization project consisted of reducing the slope of the riverbank to 1.5:1 to 2:1 (H:V) and covering the soil with erosion control fabric consisting of non-woven coir and polypropylene netting. The slope was revegetated with grasses (Figure 32).

The upstream stabilization project also consisted of reducing the riverbank slope and planting with grasses and woody species (plants were spaced 3 to 5 feet apart). Geosynthetic weed barrier fabric (3-foot square) and rigid net tube browse protectors were installed to improve plant survival. Stone was placed along the toe of the bank to a height of 4 feet at a slope of 1.75:1 (H:V). The stone averaged 6 inches in diameter (range of 4 to 18 inches) (Figure 33).

Application of Landowner Checklist

If these stabilization projects had been implemented as a single project using this guide, how would the project have been considered? The landowner checklist would likely have been completed as follows:

1) *Risk*. Risk was high where an adjacent building was threatened. Risk along the remainder of the site was low.
2) *Location and Ground Elevation*. The site is located at RM 45.3. River discharge on September 21, 2006 (when a site visit was undertaken) was 8,230 cfs. Based on Table 2, the water surface elevation at that flow is 2030.1 feet.
3) *Soil Type*. The soil is a silty loam.

Figure 32. Bioengineered bank stabilization with bank slope reduction, an earthen toe, and revegetation with grasses.

Figure 33. Bioengineered bank stabilization with a stone toe.

4) *Internal Seepage*. Existing conditions show that internal seepage occurs. The source of water may be from irrigation of adjacent land.

5) *Water Level Fluctuation*. From Figure 5, the mean water level fluctuation at this site is 3.7 feet. During wet and dry years, the fluctuation can be 5.3 and 2.2 feet, respectively. From Figure 6, the minimum and maximum mean water elevations are 2030.6 feet (August) and 2034.3 feet (June), respectively.

6) *Riverbed Configuration*. The water is 2 to 3 feet deep 30 feet out from the shore. With a slope of less than 10:1 (H:V), the riverbed has a gentle slope.

7) *Riverbank Configuration*. Before stabilization was undertaken, the bank was approximately 10 feet high, with near-vertical banks. An estimated cross-section is shown in Figure 34.

8) *Wave Action*. The site is just downstream from the Tiger Slough area, where boat traffic is common. Waves are probably common, although the configuration of the riverbed likely dampers wave action when the river stage is low.

9) *Determine Causes of Erosion*. The primary cause of bank failure was toe erosion followed by gravity collapse of cohesive banks. The erosion may have been partly due to removal of riverbank vegetation. Subsurface seepage may have also been a cause of bank failure.

10) *Determine Applicable Bank Stabilization Techniques*. The bank stabilization measures were implemented in 2004 and the late 1990s. This guide was not available at the time this stabilization was designed.

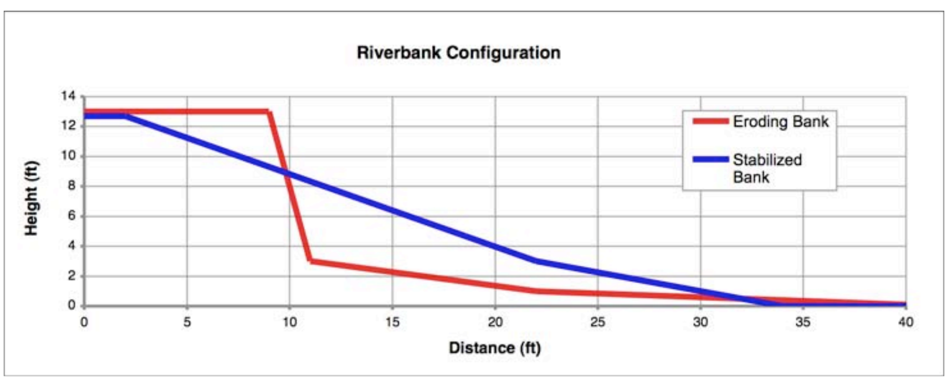
11) *Determine Materials Required for the Applicable Measures*. The quantities of stone, erosion control fabric and containerized plants was not available.

12) *Estimate the Cost of Applicable Techniques*. The cost to design and implement the bank stabilization projects was not available. Based on the costs outlined in this guideline, implementation of the 2004 bank stabilization work would have cost $15,000 to $20,000.

13) *Contact Washington Department of Fish and Wildlife.* WDFW reviewed the stabilization project during preliminary planning.

14) *Submit Permit*. The applicant submitted the Joint Aquatic Resource Permit Application (JARPA) to the WDFW and received permit approval on July 1, 2004.

Figure 34. Schematic cross-section of the riverbank at RM 45.3 before and after installation of bank stabilization measures.



Evaluation of Project Success

Were the implemented projects successful? The site was stabilized using the techniques of bank slope reduction with and without toe armoring. The bank slope was stabilized with erosion control fabric and plants. The projects have been largely successful, as the site is stable and vegetation is thriving. Following are some observations:

- *Stone Toe*. Stone was placed along the toe of the slope to a height of 4 feet. The calculated mean river stage fluctuation at this site is 3.7 feet. The height and elevation of the stone was appropriate for the site hydrology. The stone at the bank toe appears stable; no stone has been dislodged. The size of the stone was not too small.
- *Upper Bank*. The earth slope is generally stable, except in a few locations where subsurface seepage has caused small, localized slumps. The source of water may be from over-irrigation of the adjoining fields.
- *Revegetation*. Red osier dogwood has exhibited a high survival rate (>90%), although upland species higher on the bank have a survival rate of less than 50%.

What other or additional stabilization measures might have been implemented to improve the project success? Again, some observations:

- *Intermittent Slope Break*. Where the vegetated riverbank is 10-feet high, a slope break could have been placed midway on the bank to interrupt surface flow.
- *Stone and Vegetated Toe*. The two projects provide a means to compare providing bank stability with and without a stone toe. The reach of riverbank with the stone toe is stable, but the reach without a stone toe also appears to afford adequate stability. This comparison highlights the essential question of whether or not the bank toe should be protected with stone. Because there was a high erosion risk along the riverbank due to proximity of the house, a stone toe was justifiable. At the same time, some features might have been included in the stone toe to reduce the environmental and visual impacts (see items below).
- *Low Bench*. A low bench could have been installed as part of both stabilization projects. Such a bench might have provided a site for sedge and willow to become established. Note in Figure 32 that sedge has become well established along a portion of the bank where the stone toe was not employed. Hardstem bulrush was also observed along the toe of this bank.
- *Willows*. Willow cuttings could have been placed at the time the rock toe was installed so willows could grow through the rock, thereby improving stability and obscuring the rock from view. For the reach of re-sloped bank stabilized only with grasses, willow fascines could also have been installed along the bank to speed the establishment of woody vegetation.
- *Erosion Control Fabric*. The erosion control fabric used at both sites consisted of non-woven coir held together with plastic netting. Although the coir fibers have degraded, the plastic netting remains. Since the netting is not needed for slope stability, a fully biodegradable fabric might have been used.
- *Topsoil*. At several locations along both projects, the topsoil consists of a thin layer (<1 inch) over compacted clay. These conditions have limited the health and density of the grasses that have re-established. Improved revegetation

success would result from efforts to reduce clay compaction and increase the depth of topsoil.

- *Internal Drainage*. Since internal drainage occurs along some portions of the riverbank, measures could have been implemented that might have improved stability. Providing internal gravel drains was not likely practical. A surface treatment of willow fascines (as described above) might have provided surface structural support and might have interrupted flow as it reached the bank surface. Intermittent slope breaks might also have interrupted these flow patterns.

Shoreline Access

Access to the reservoir is important to most landowners with shoreline property. Most landowners have, at a minimum, some means to readily access the water's edge; many also have boat docks. Landowner access along the reservoir takes the form of cleared trails, graveled paths, wooden stairs, stone or concrete steps, and gangways. Some methods of access have been placed to carefully blend with the surrounding topography and vegetation, to the point that they are often indistinguishable (Figure 35). Other access methods are superimposed upon the riverbank such that bank slopes have been greatly modified and wide swaths of vegetation have been removed (Figure 36). Ongoing maintenance practices at many sites often prevent vegetation reestablishment.

One innovative method of providing access to the river while minimizing the impact to riparian vegetation is the use of an "over-head" gangway to access boat docks (Figure 37). Several adjacent landowners upstream from Cusick have installed these overhead gangways. Disturbance to riverbank vegetation is limited to the placement of support pilings; vegetation can grow unrestricted around the gangway. As with all docks and gangway ramps, these features need to be maintained to prevent damage during high flow and periods of ice.

Figure 35. Shoreline access with minimal impact to bank stability and adjacent vegetation.

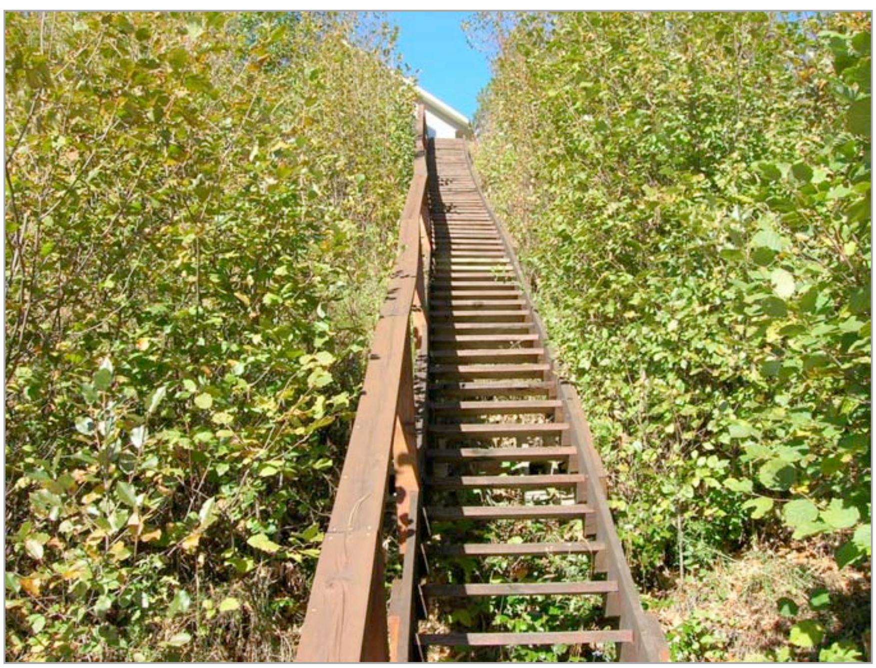


Figure 36. Access with extensive modification to the riverbank and associated vegetation.

Figure 37. Overhead dock access commonly used in along a portion of the river upstream of Cusick (in foreground). Note (in background) the riverbank disturbance associated with traditional wooden stairs used for dock access.

6. PERMIT REQUIREMENTS

This document focuses on designing riverbank stabilization projects along the Pend Oreille River within the Box Canyon Reservoir that will qualify for approval of the State of Washington's Hydraulic Permit Approval permit. Riverbank stabilization projects also require review by local government agencies, other state agencies, and the U.S. Army Corps of Engineers. It is the responsibility of the landowner to acquire all necessary permits for work along the river prior to starting work on any project.

Hydraulic Permit Approval

The law requires that any person, organization, or government agency wishing to conduct any construction activity that will use, divert, obstruct, or change the bed or flow of state waters must do so under the terms of a permit (called the Hydraulic Project Approval or HPA) issued by the WDFW. State waters include all fresh waters, of which the Pend Oreille River qualifies.

How Do I Apply For An HPA?

The form to apply for an HPA is called a Joint Aquatic Resource Permit Application (JARPA). This application form is contained in *Appendix 3 HPA Permit*. The JARPA consolidates seven permit application forms for federal, state and local permits. JARPA is used to apply for an HPA and also for Water Quality Certifications or Modifications from the Department of Ecology, Aquatic Resource Use Authorizations from the Department of Natural Resources, Army Corps of Engineers permits, and Shoreline Management Act Permits from participating local city or county agencies. Currently, not all local government agencies use JARPA. You should contact your local planning office to determine if they accept JARPA documents. JARPA forms are available from any Department of Fish and Wildlife office, as well as from any Department of Ecology, Army Corps of Engineers, or participating local government offices. Stop in at the nearest office and pick up an application, call or write and one will be mailed to you, or go online at http://www.ecy.wa.gov/biblio/ecy07015.html. Copies of the JARPA form must be submitted to all participating agencies that require a permit for your project, including the WDFW. There is no charge for the HPA.

What Constitutes Complete Plans and Specifications When Applying for an HPA?

See Table 5 for guidance in identifying what constitutes complete plans and specifications for an HPA.

Do I Need to Include Anything with my Application?

JARPA must include general plans for the project, complete plans and specifications for the proposed construction or work within the ordinary high water line, and complete plans and specifications for the proper protection of fish life. State Environmental Policy Act (SEPA) compliance must be completed prior to review of your application and issuance of the HPA by WDFW. SEPA compliance is not required for an expedited or an emergency HPA.

You can find the name and contact information of the Area Habitat Biologist that likely will process your application by referring to the online list at:

http://wdfw.wa.gov/hab/ahb

or by calling the Olympia Habitat Program office at (360) 902-2534.

Table 5. Guidance for identifying what constitutes complete plans and specifications for an HPA.

General Plans for Overall Project	Complete Plans and Specifications for Work Waterward of OHWL/MHHW	Complete Plans and Specifications for the Proper Protection of Fish Life
WDFW needs sufficient detail to accurately know:	WDFW needs sufficient detail to fully understand what is being proposed so they can review the project without the need for additional information from the applicant:	While WDFW is ultimately the agency that will determine what is needed for proper protection of fish life, they still need to know what measures the applicant plans to use to avoid or reduce adverse impacts from the proposed project. The standard of protection that WDFW uses is "no net loss[4]." At a minimum, these questions need to be addressed:
1) What it is the applicant wants to do; what is the size, scale and scope of the project; include dimensions and accurate plan and cross-view drawings of the project, etc? 2) Where is the work going to occur; what is the project's location; include a vicinity map and other drawings that show the project in relationship to the ordinary high water line[1], the channel migration zone[2] and the 100-year floodplain[3].	1) How does the applicant plan to do the work? 2) When does the applicant want to do the work? 3) What equipment will the applicant use and how will the applicant use that equipment? 4) Will work be sequenced? If so, how? 5) Is the applicant under timing constraints for any part, or the entire project? 6) Will explosives be used?	1) How does the applicant plan to control sediment delivery and erosion resulting from the project? 2) How will the applicant address potential oil or gasoline spills or leakages that might occur from equipment use? 3) If in-water work is to occur, what method(s) will the applicant use to temporarily divert the water from the work area? 4) How does the applicant propose to keep fish life out of the work area? 5) Does the applicant plan to remove riparian vegetation[5], and if so, what is the plan to replace that vegetation? 6) Will heavy equipment be operated below the OHWL[1]; will equipment be staged on the bank or some structure, or will it work from within the water?

[1] Ordinary high water line (OHWL) = the mark on the shores of all waters that will be found by examining the bed and banks and ascertaining where the presence and action of waters are so common and usual and so long continued in ordinary years, as to mark upon the soil or vegetation a character distinct from that of the abutting upland: Provided, That in any area where the ordinary high water line cannot be found the ordinary high water line adjoining saltwater shall be the line of mean higher high water and the ordinary high water line adjoining freshwater shall be the elevation of the mean annual flood (Hydraulic Code Rules, WAC 220-110-020 (57)).

[2] Channel migration zone = the area where the active channel of a stream is prone to movement over time (Floodplains and Channel Migration Zones, Jerry Gorseline, WA Environmental Council, 3/28/01); = the area along a river within which the channel(s) can be reasonably predicted to migrate over time as a result of natural and normally occurring hydrological and related processes when considered with the characteristics of the river and its surroundings (Shoreline Management Act rule, WAC 173-26-020 (6)).

[3] 100-year floodplain = that land area susceptible to inundation with a one percent chance of being equaled or exceeded in any given year. The limit of this are shall be based upon flood ordinance regulation maps or a reasonable method which meets the objectives of the act [Shoreline Management Act] (Shoreline Management Act rule, WAC 173-26-020 (15)); = (1) Area adjoining a water body that becomes inundated during periods of overbank flooding and that is given rigorous legal definition in regulatory programs. (2) Land beyond a stream channel that forms the perimeter for the maximum probability flood. (3) Strip of land bordering a stream that is formed by substrate deposition. (4) Deposit of alluvium that covers a valley flat from lateral erosion of meandering streams and rivers (Glossary of Aquatic Habitat Inventory Terminology, Neil B. Armantrout, American Fisheries Society, 1998).

[4] No-net-loss = (a) Avoidance or mitigation of adverse impacts to fish life; or (b) Avoidance or mitigation of net loss of habitat functions necessary to sustain fish life; or (c) Avoidance or mitigation of loss of area by habitat type. Mitigation to achieve no-net-loss should benefit those organisms being impacted (WAC 220-110-020 (56)).

[5] Riparian vegetation = vegetation growing on or near the banks of a stream or other water body that is more dependent on water than vegetation that is found further upslope (Glossary of Aquatic Habitat Inventory Terminology, Neil B. Armantrout, American Fisheries Society, 1998).

Section 404 of the Clean Water Act

The U.S. Army Corps of Engineers (COE) has authority to regulate the discharge of dredged or fill material into waters of the U.S. under Section 404 of the Clean Water Act. Bank stabilization projects that meet certain criteria may qualify for approval by the COE under Regional General Permit 4 (RGP-4). There are two criteria under this general permit that place a limit on the allowable extent of bank stabilization. To qualify for RPG-4, these criteria must be met:

- The bank stabilization activity does not exceed 250 feet in length; and
- The activity does not exceed an average of one-half cubic yard of material per running foot placed along the riverbank below the plane of the ordinary high water mark.

If a proposed project does not meet these criteria, then an applicant will need to apply for an individual permit through the COE. For more information on RGP-4 and individual permits, visit:

http://www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=REG&pagename=Home_Page

or contact:

U.S. Army Corps of Engineers
Eastern Washington Field Office
Post Office Box 273
Chattaroy, Washington 99003-0273
Telephone: (509) 238-4570

Pend Oreille County Shoreline Master Plan

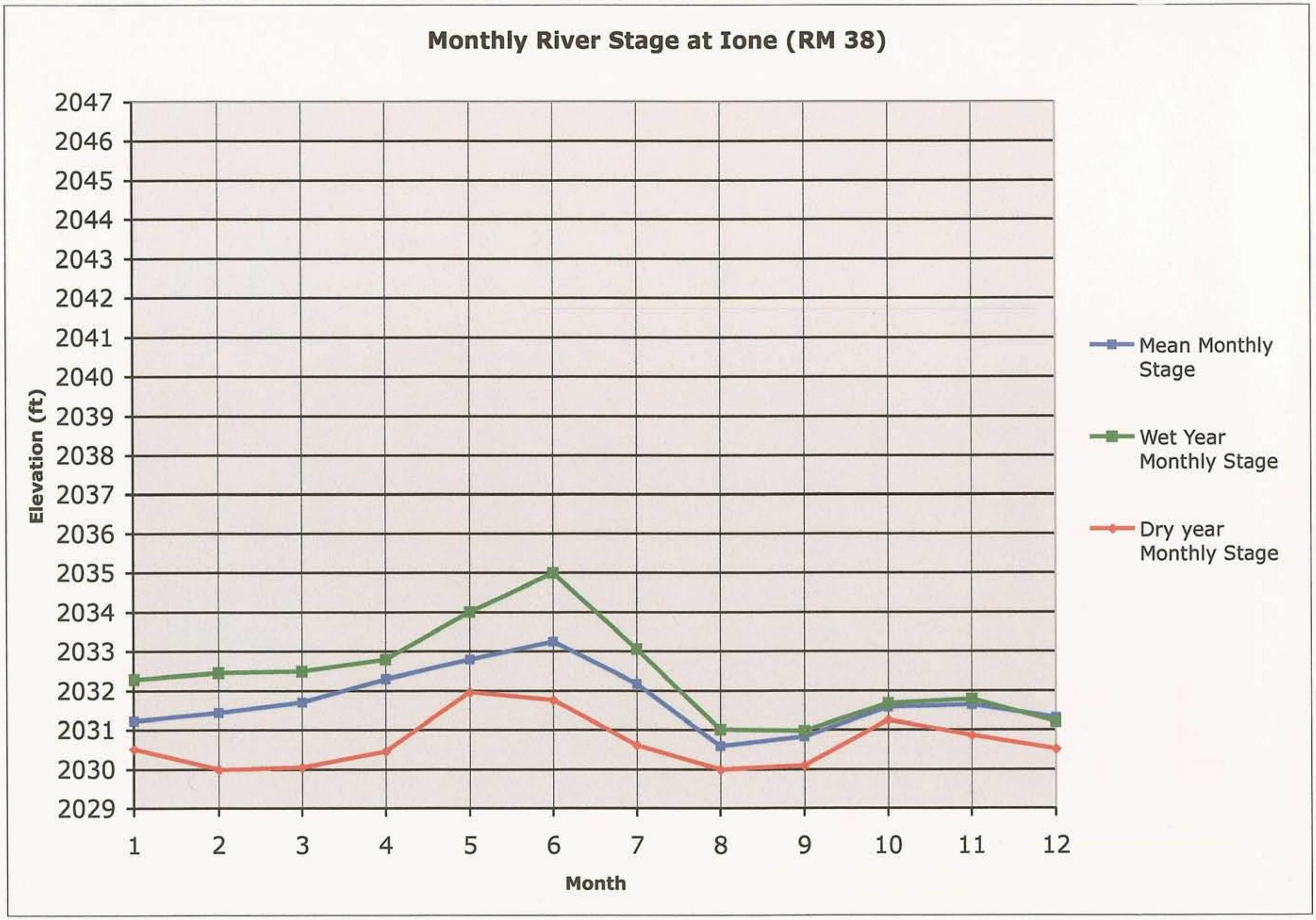
Pend Oreille County has jurisdiction over the shorelines of statewide significance in Pend Oreille County. County jurisdiction applies to any development within 200 feet of the Ordinary High Water Mark of the Pend Oreille River, Sullivan Creek and Calispel Lake, and shorelines associated with shorelines of statewide significance, which includes reservoirs and their associated wetlands.

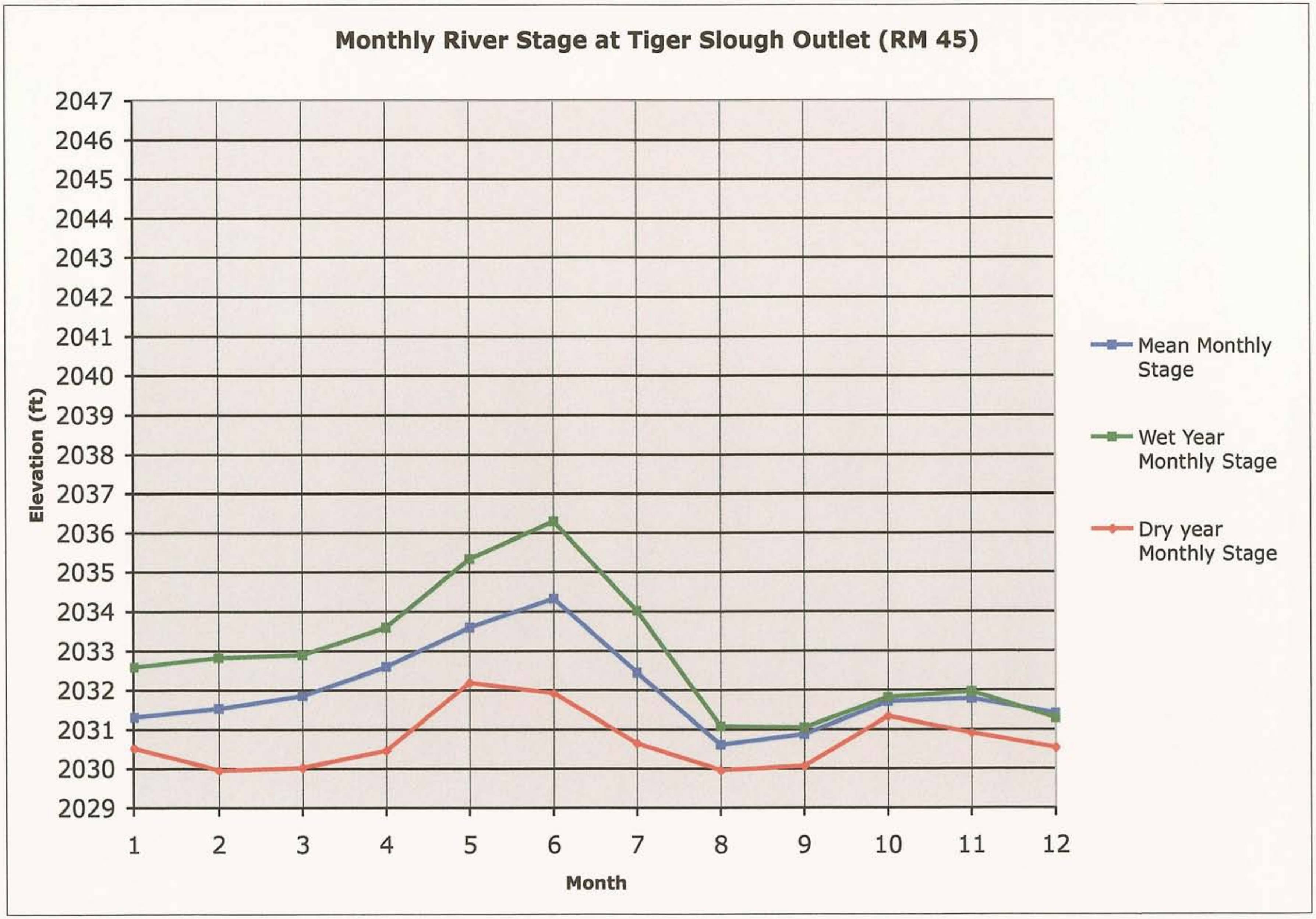
Any development within the shoreline area must have a permit issued by the Pend Oreille County Planning Department. Applicants with projects that have a total cost, or fair market value, that exceeds $5,000 must acquire a Substantial Shoreline Development Permit. Applicants who intend to construct a dock designed for pleasure craft, limited to private, noncommercial use of the owner, lessee or contract purchaser of a single-family residence, the cost of which exceeds $10,000, must also acquire a Substantial Shoreline Development Permit.

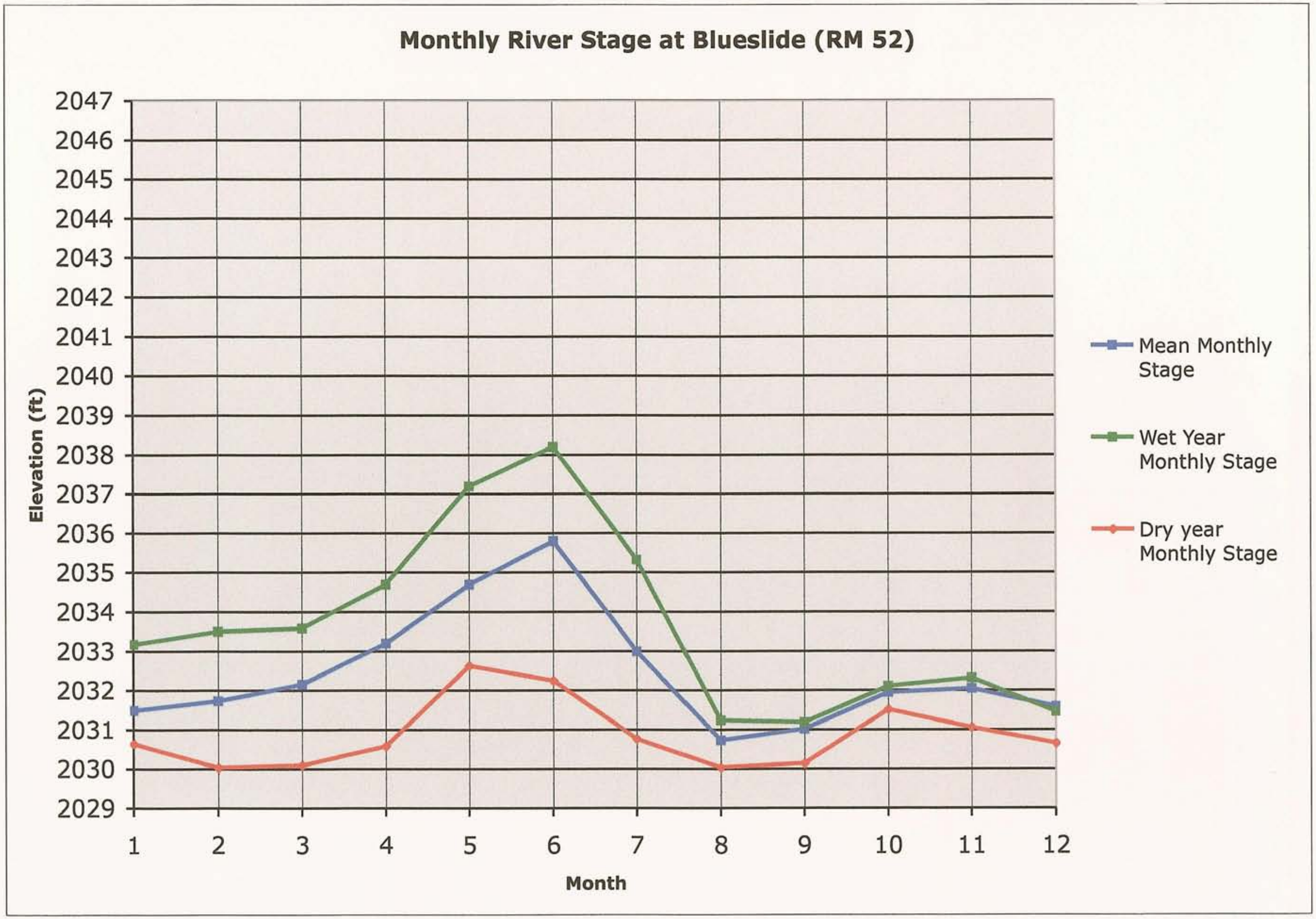
If you have any questions regarding working on the shoreline, contact the Pend Oreille County Planning and Building Department.

P.O. Box 5066
Newport, WA 99156
Telephone: (509) 447-4821
Facsimile: (509) 447-5890
www.co.pend-oreille.wa.us

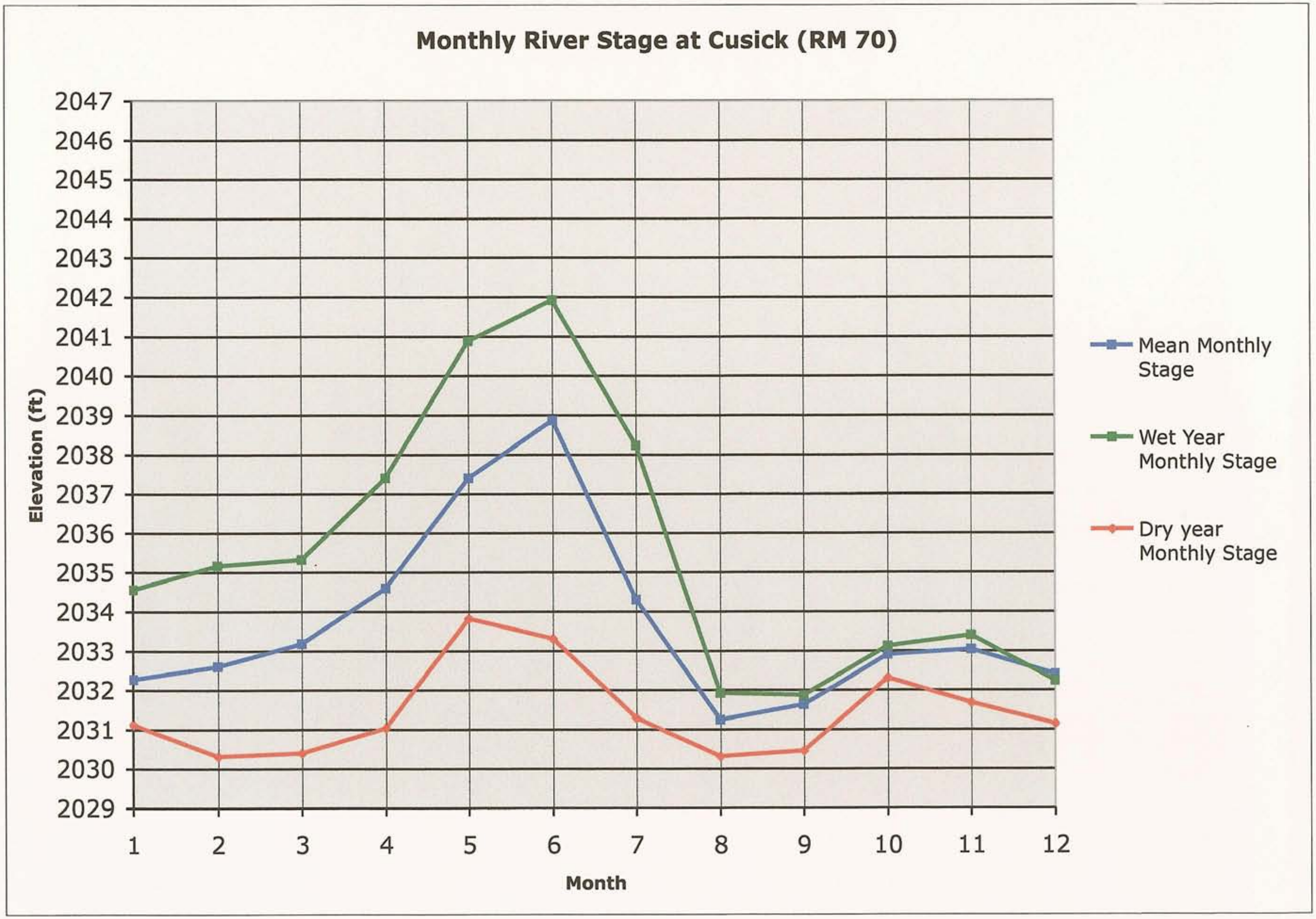
Appendix 1 Stage Variation

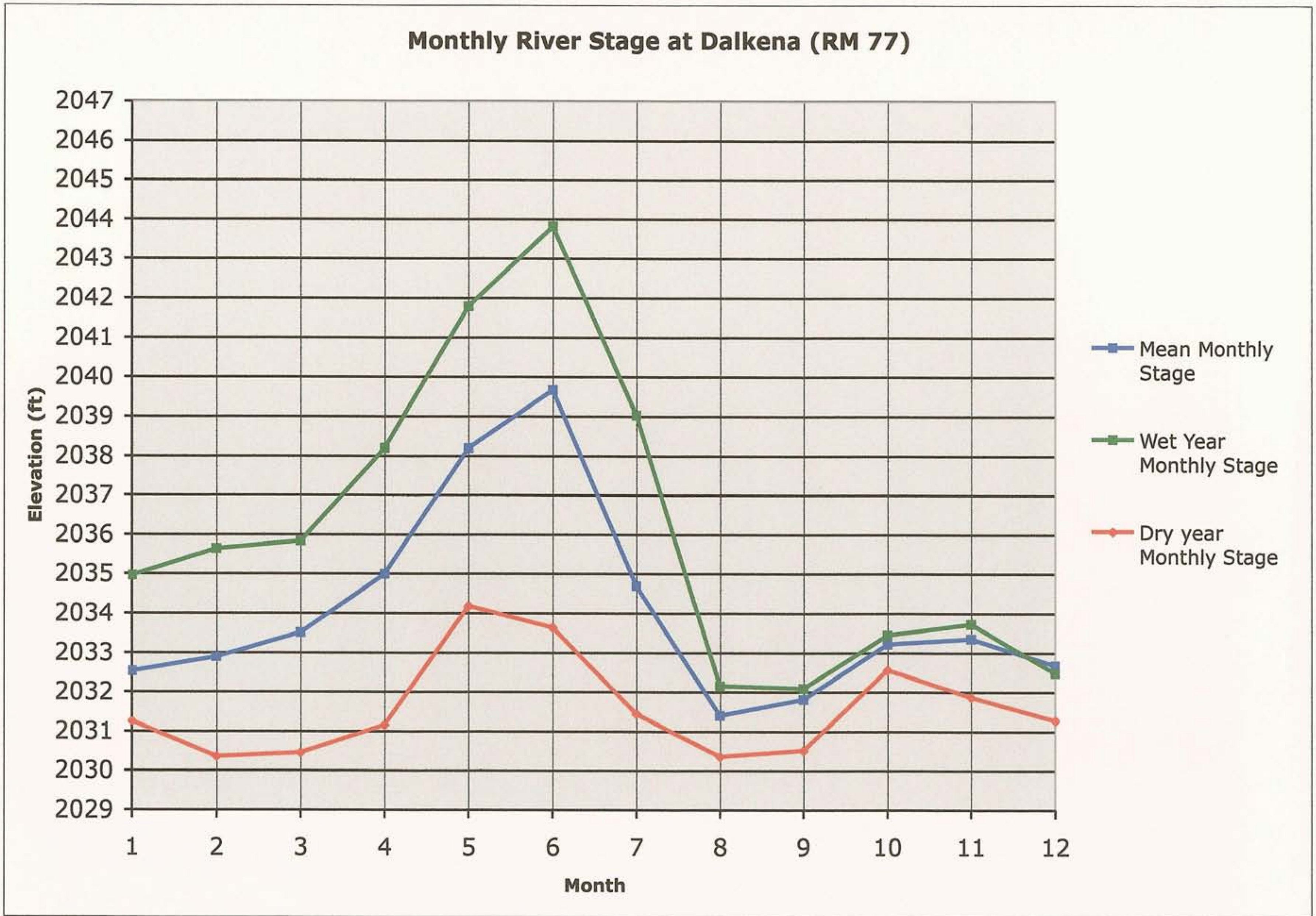

Monthly River Stage at Ione (RM 38)
Elevation (ft)
2047
2046
2045
2044
2043
2042
2041
2040
2039
2038
2037
2036
2035
2034
2033
2032
2031
2030
2029
1
2
3
4
5
6
7
8
9
10
11
12
Month
Mean Monthly Stage
Wet Year Monthly Stage
Dry year Monthly Stage


Monthly River Stage at Tiger Slough Outlet (RM 45)
Elevation (ft)
2047
2046
2045
2044
2043
2042
2041
2040
2039
2038
2037
2036
2035
2034
2033
2032
2031
2030
2029
1
2
3
4
5
6
7
8
9
10
11
12
Month
Mean Monthly Stage
Wet Year Monthly Stage
Dry year Monthly Stage

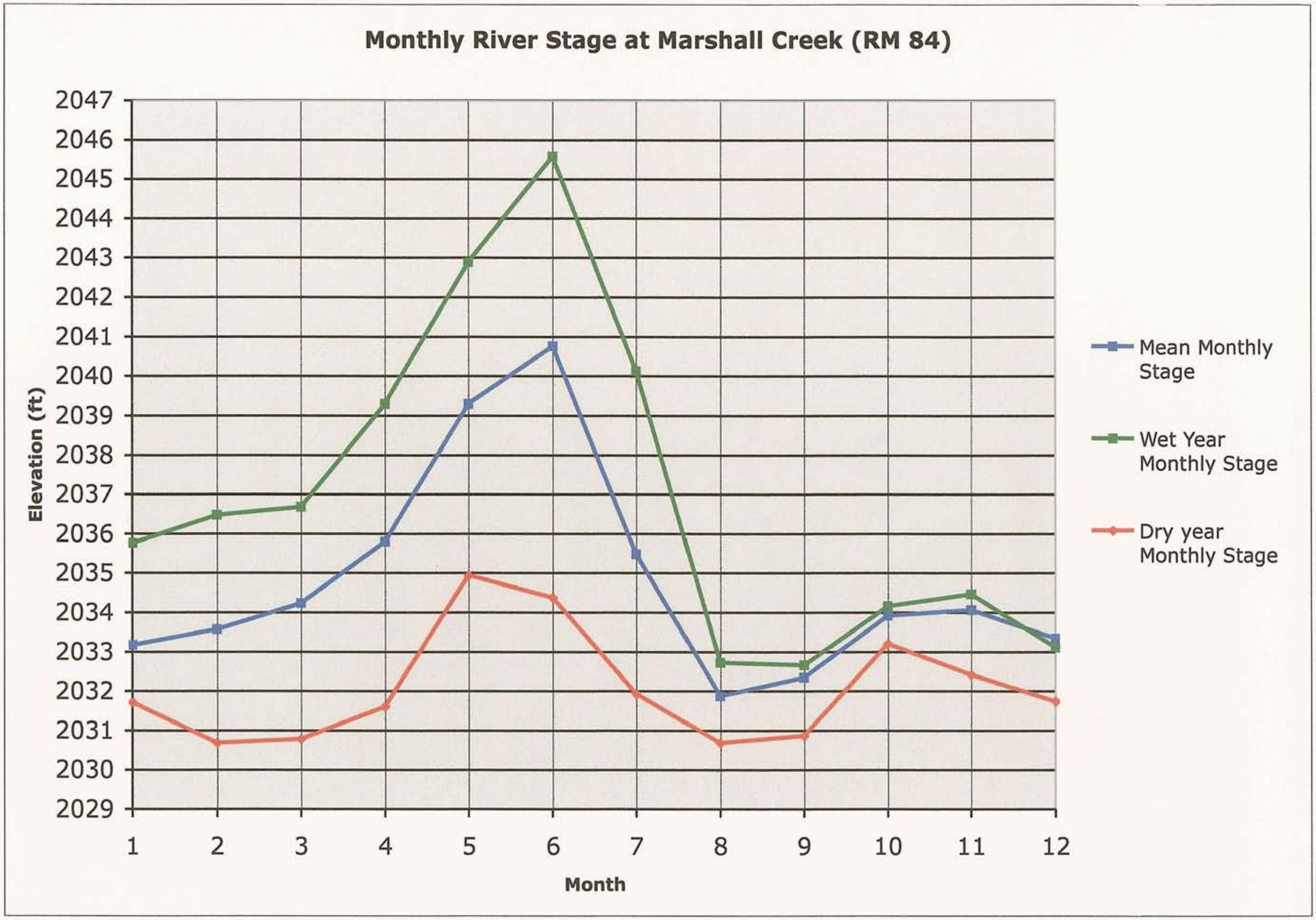

Monthly River Stage at Blueslide (RM 52)
Elevation (ft)
2047
2046
2045
2044
2043
2042
2041
2040
2039
2038
2037
2036
2035
2034
2033
2032
2031
2030
2029
1
2
3
4
5
6
7
8
9
10
11
12
Month
Mean Monthly Stage
Wet Year Monthly Stage
Dry year Monthly Stage

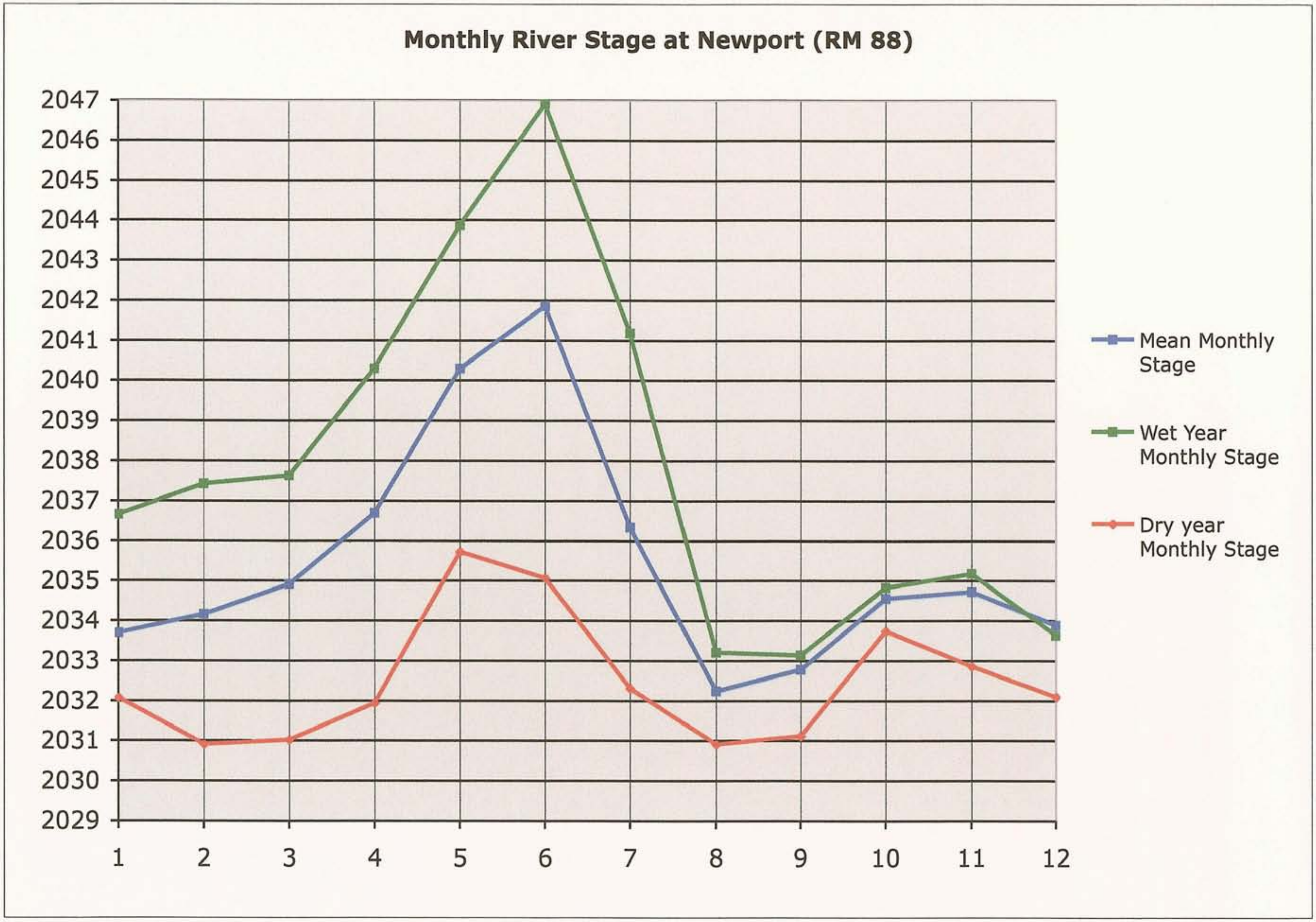

Monthly River Stage at River Bend (RM 60)
Elevation (ft)
2047
2046
2045
2044
2043
2042
2041
2040
2039
2038
2037
2036
2035
2034
2033
2032
2031
2030
2029
1
2
3
4
5
6
7
8
9
10
11
12
Month
Mean Monthly Stage
Wet Year Monthly Stage
Dry year Monthly Stage


Monthly River Stage at Cusick (RM 70)
Elevation (ft)
2047
2046
2045
2044
2043
2042
2041
2040
2039
2038
2037
2036
2035
2034
2033
2032
2031
2030
2029
1
2
3
4
5
6
7
8
9
10
11
12
Month
Mean Monthly Stage
Wet Year Monthly Stage
Dry year Monthly Stage

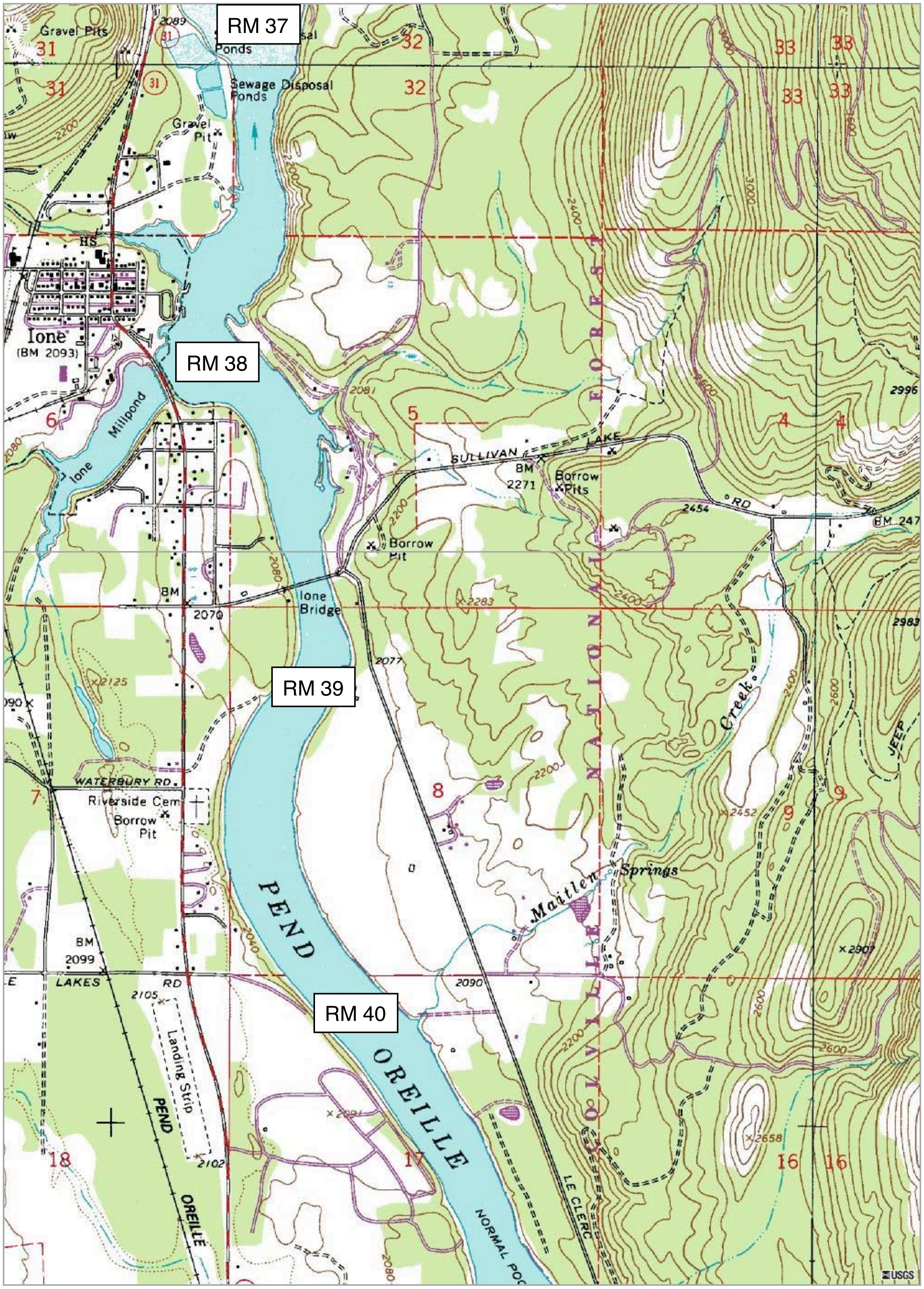


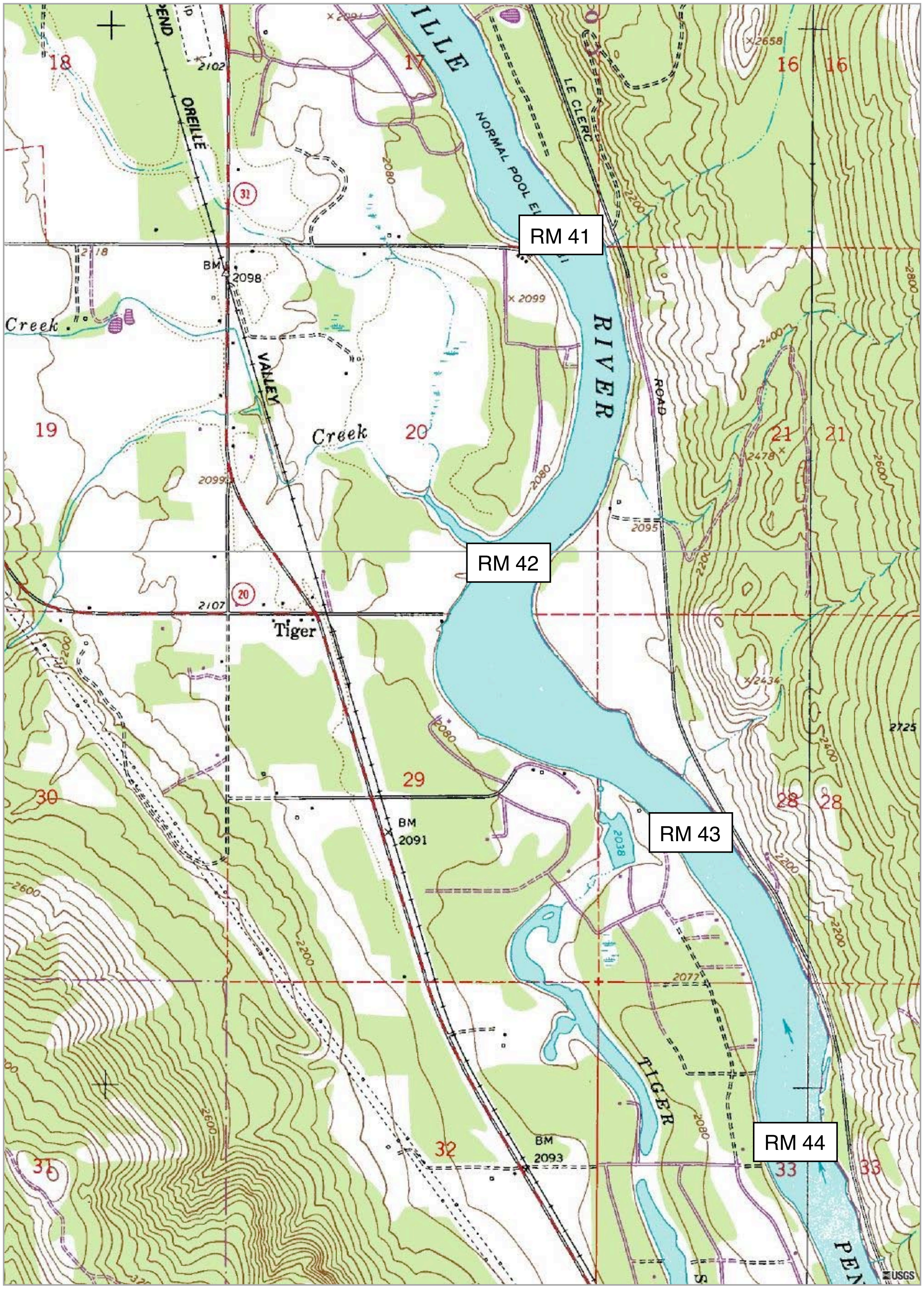
Monthly River Stage at Dalkena (RM 77)
Elevation (ft)
2047
2046
2045
2044
2043
2042
2041
2040
2039
2038
2037
2036
2035
2034
2033
2032
2031
2030
2029
1
2
3
4
5
6
7
8
9
10
11
12
Month
Mean Monthly Stage
Wet Year Monthly Stage
Dry year Monthly Stage


Monthly River Stage at Marshall Creek (RM 84)
Elevation (ft)
2047
2046
2045
2044
2043
2042
2041
2040
2039
2038
2037
2036
2035
2034
2033
2032
2031
2030
2029
1
2
3
4
5
6
7
8
9
10
11
12
Month
Mean Monthly Stage
Wet Year Monthly Stage
Dry year Monthly Stage

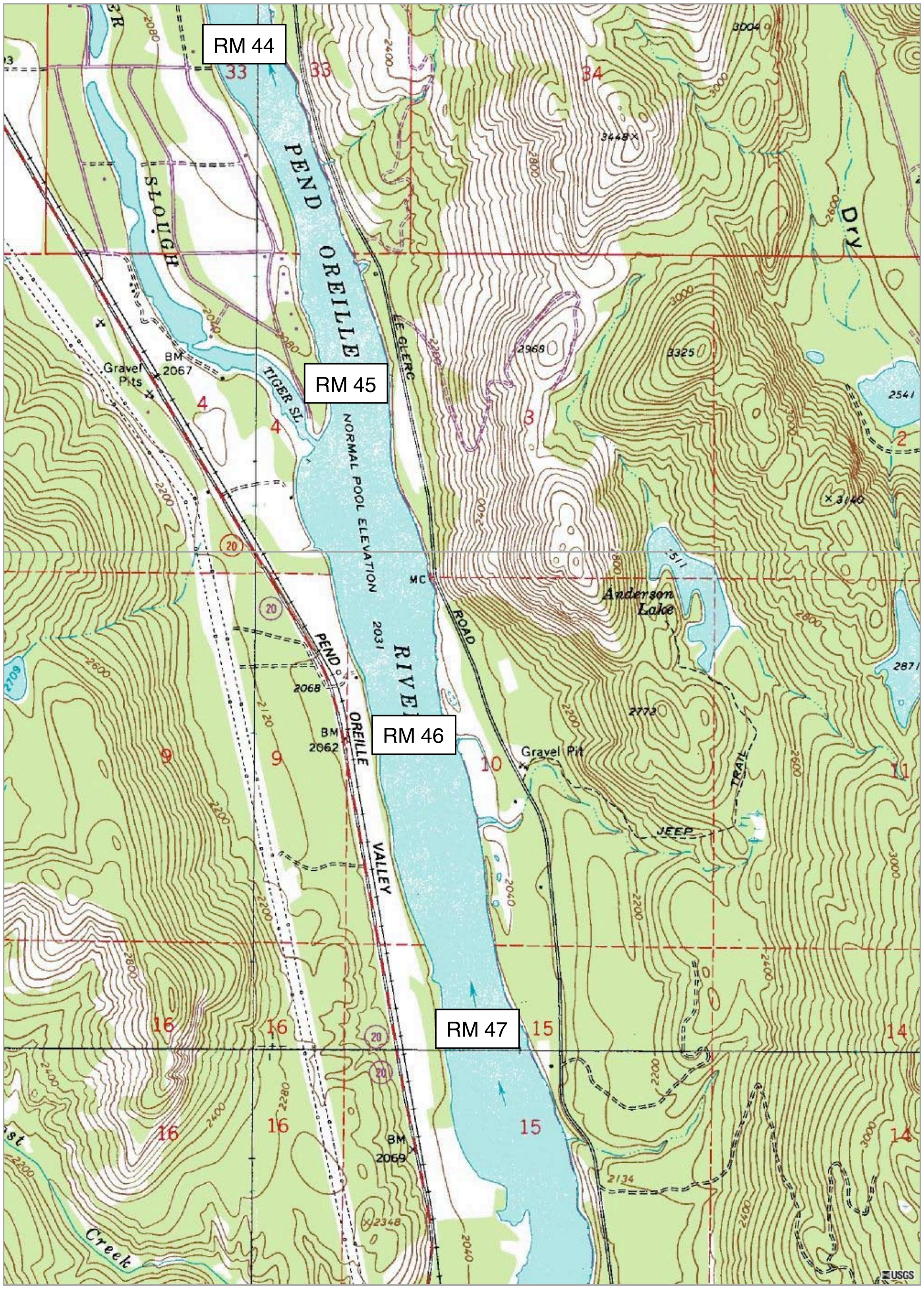

Monthly River Stage at Newport (RM 88)
2047
2046
2045
2044
2043
2042
2041
2040
2039
2038
2037
2036
2035
2034
2033
2032
2031
2030
2029
1
2
3
4
5
6
7
8
9
10
11
12
Mean Monthly Stage
Wet Year Monthly Stage
Dry year Monthly Stage

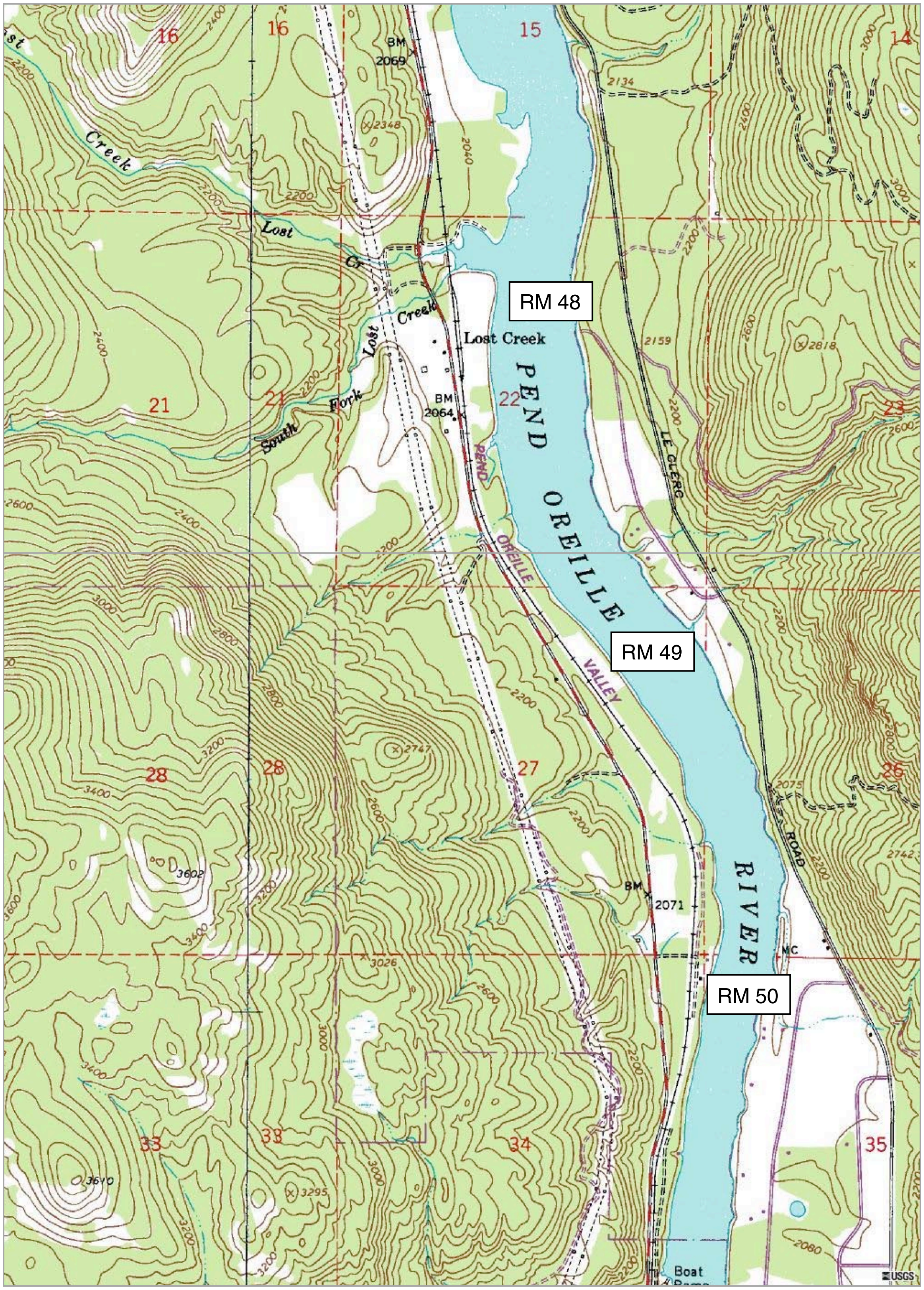
Appendix 2 Location By River Mile

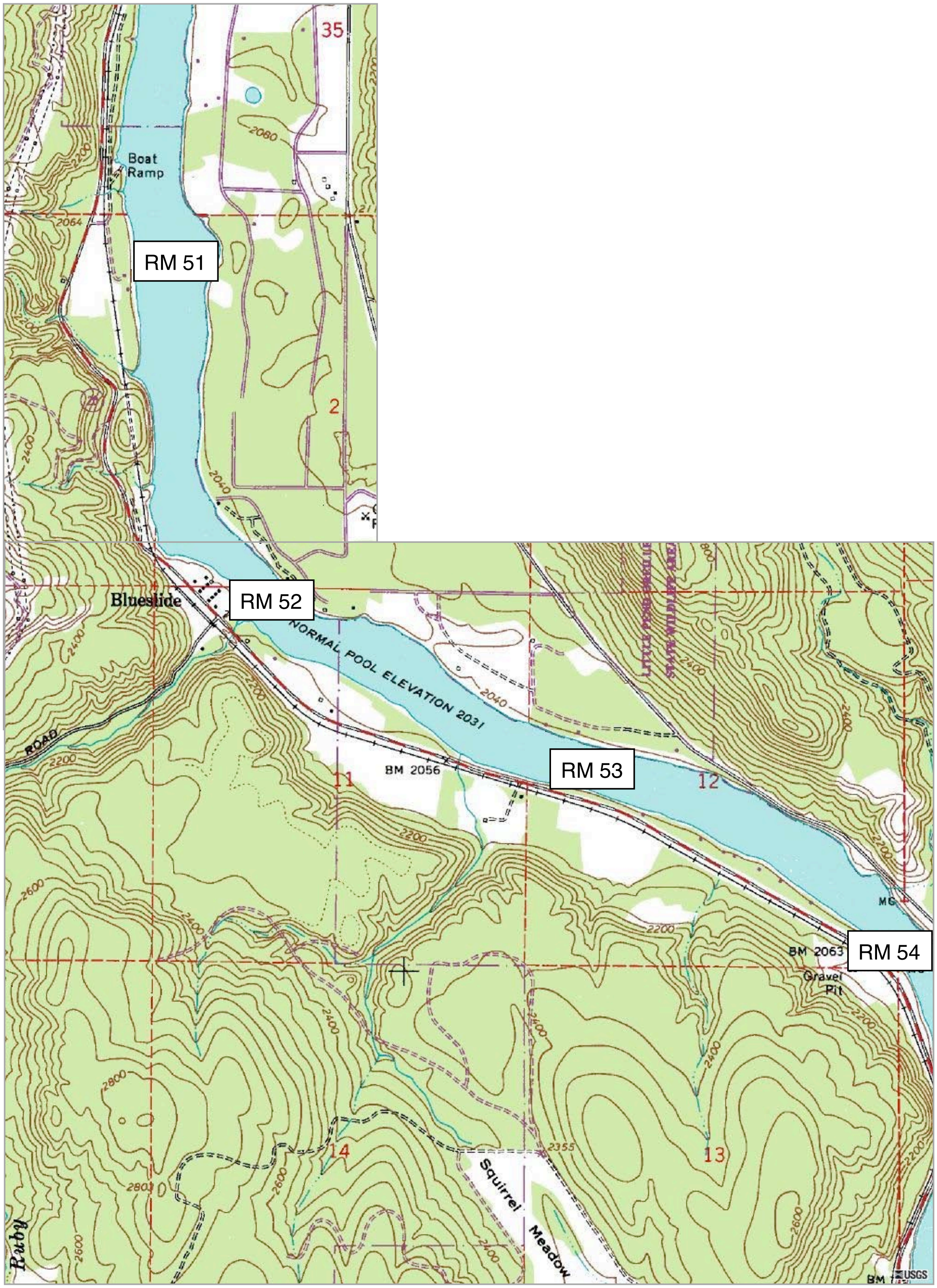

RM 37
RM 38
RM 39
RM 40
Gravel Pits
Sewage Disposal Ponds
Gravel Pit
Ione
(BM 2093)
Ione Millpond
Ione Bridge
SULLIVAN LAKE RD
Borrow Pits
Borrow Pit
WATERBURY RD
Riverside Cem
LAKES RD
Landing Strip
PEND OREILLE
Maitlen Springs
Creek
COLVILLE NATIONAL FOREST
LE CLERC
NORMAL PO
JEEP
USGS



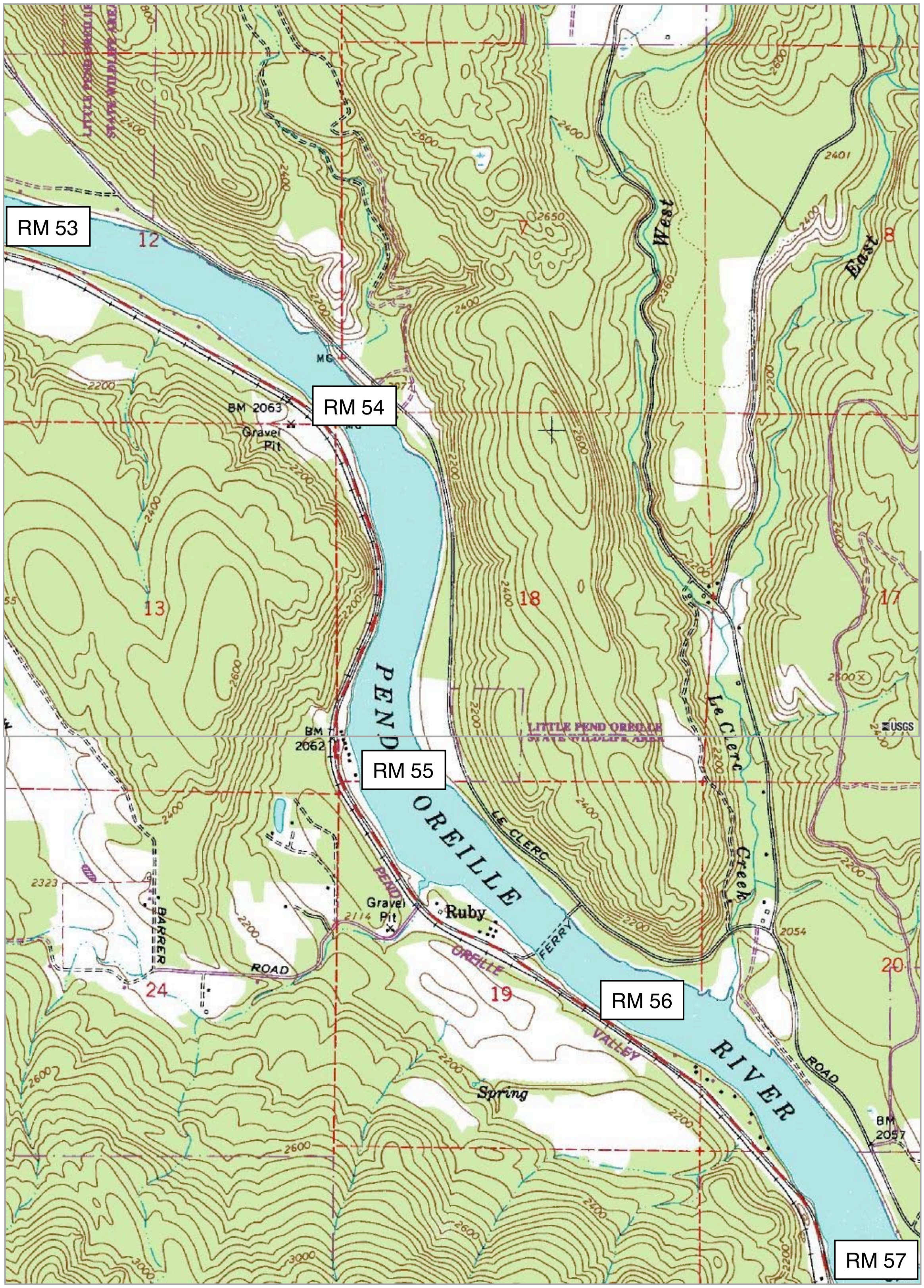
RM 41
RM 42
RM 43
RM 44
RIVER
NORMAL POOL EL
LE CLERC
ROAD
OREILLE
VALLEY
Creek
Creek
Tiger
TIGER
BM 2098
BM 2091
BM 2093
18
17
16
16
19
20
21
21
30
29
28
28
31
32
33
33


RM 44
RM 45
RM 46
RM 47
PEND OREILLE RIVER
NORMAL POOL ELEVATION 2031
SLOUGH
TIGER SL.
LE CLERC ROAD
PEND OREILLE VALLEY
Anderson Lake
Gravel Pits
Gravel Pit
JEEP TRAIL
Dry
Creek
BM 2067
BM 2062
BM 2069
USGS

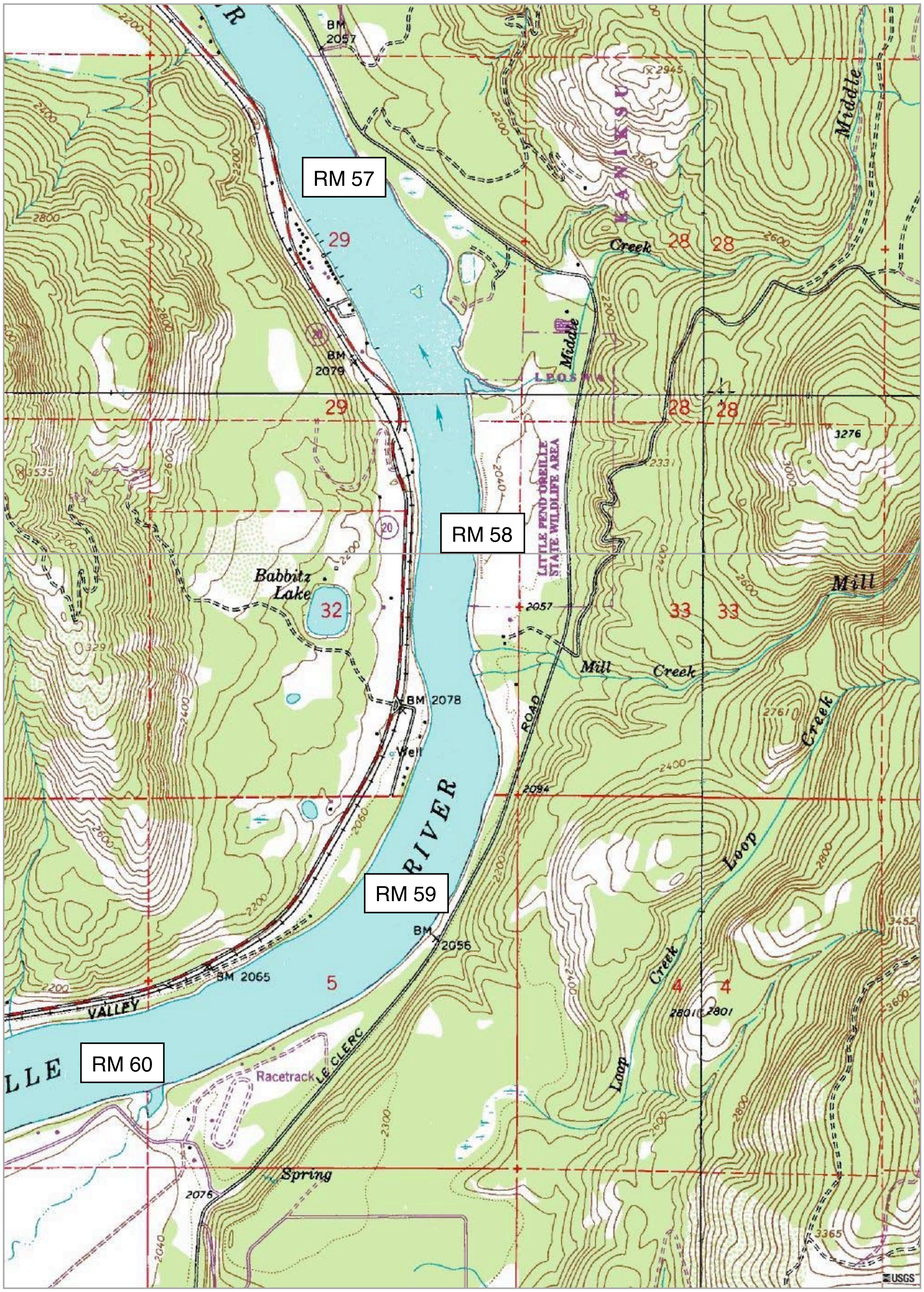

RM 48
RM 49
RM 50
PEND OREILLE RIVER
Lost Creek
Lost Cr
South Fork Lost Creek
LE CLERC ROAD
PEND OREILLE VALLEY
Boat Ramp
USGS



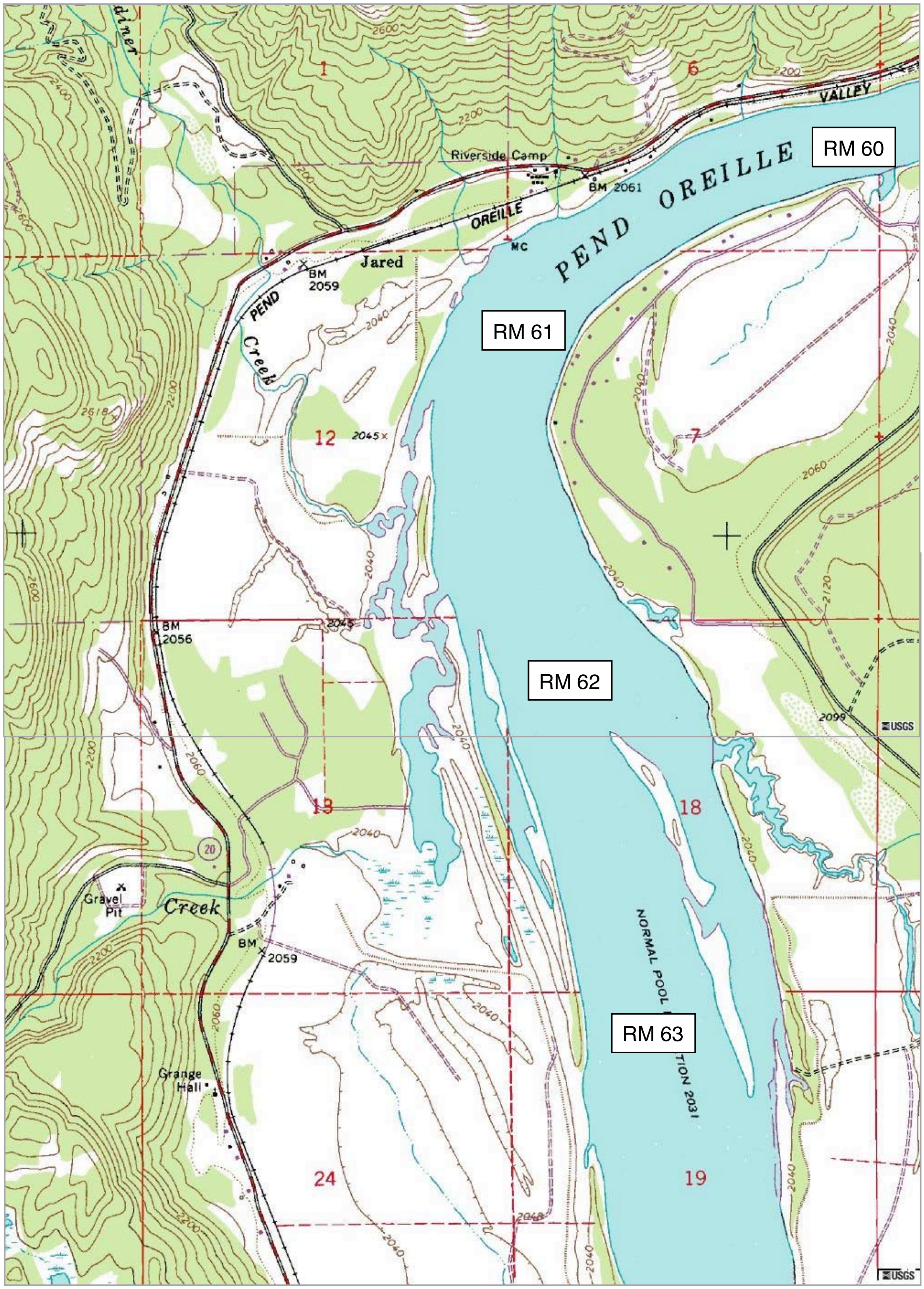
35
Boat Ramp
2080
2064
RM 51
2
2040
Blueslide
RM 52
NORMAL POOL ELEVATION 2031
2040
2400
ROAD
2200
11
BM 2056
RM 53
12
2200
2600
2400
BM 2063
RM 54
Gravel Pit
2800
14
2355
13
Squirrel Meadow
Ruby
USGS

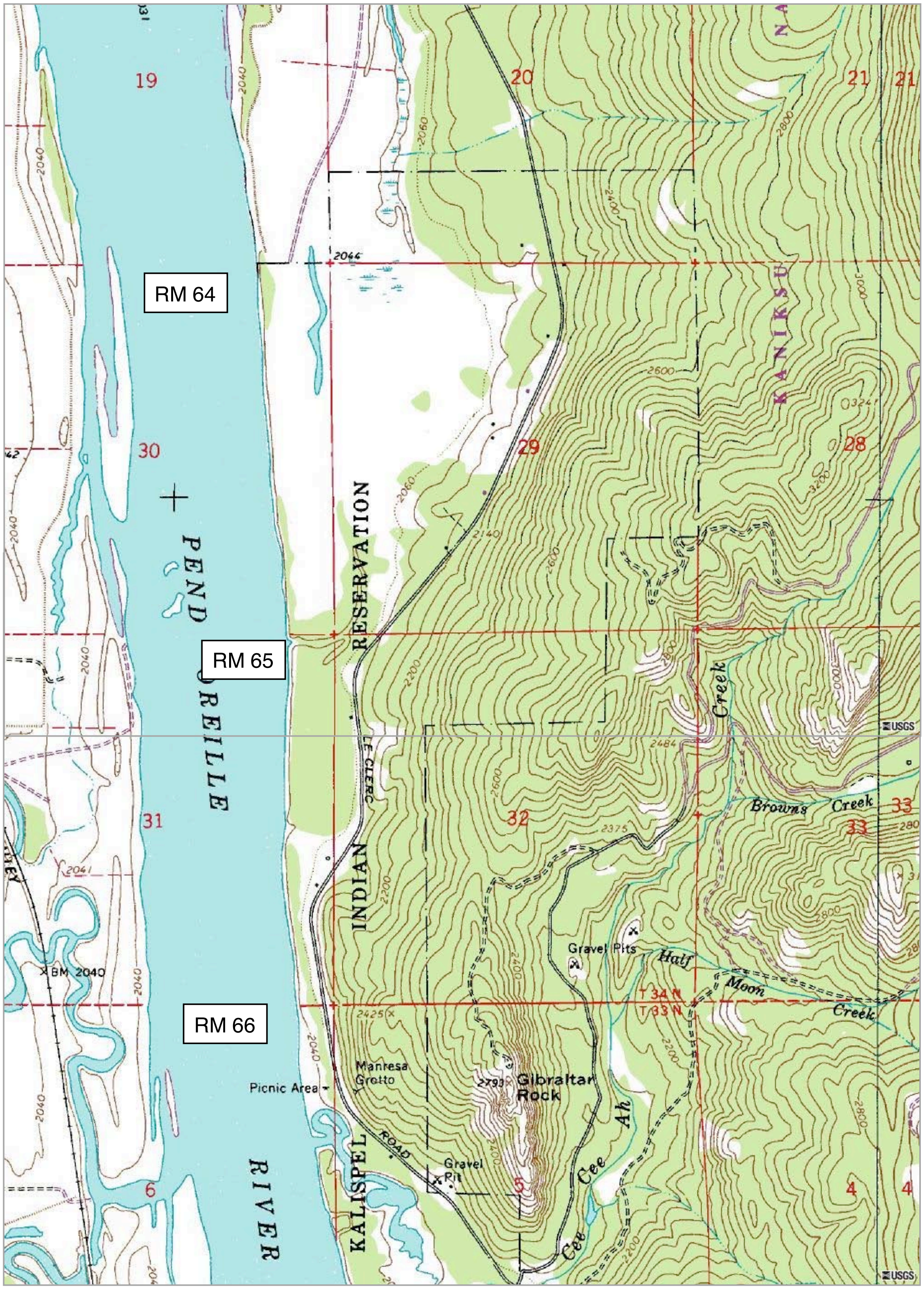


RM 53
RM 54
RM 55
RM 56
RM 57
PEND OREILLE RIVER
LITTLE PEND OREILLE STATE WILDLIFE AREA
West
East
Le Clerc Creek
LE CLERC ROAD
FERRY
Ruby
Gravel Pit
BM 2063
BM 2062
BM 2057
BARRER ROAD
PEND OREILLE VALLEY
Spring
USGS

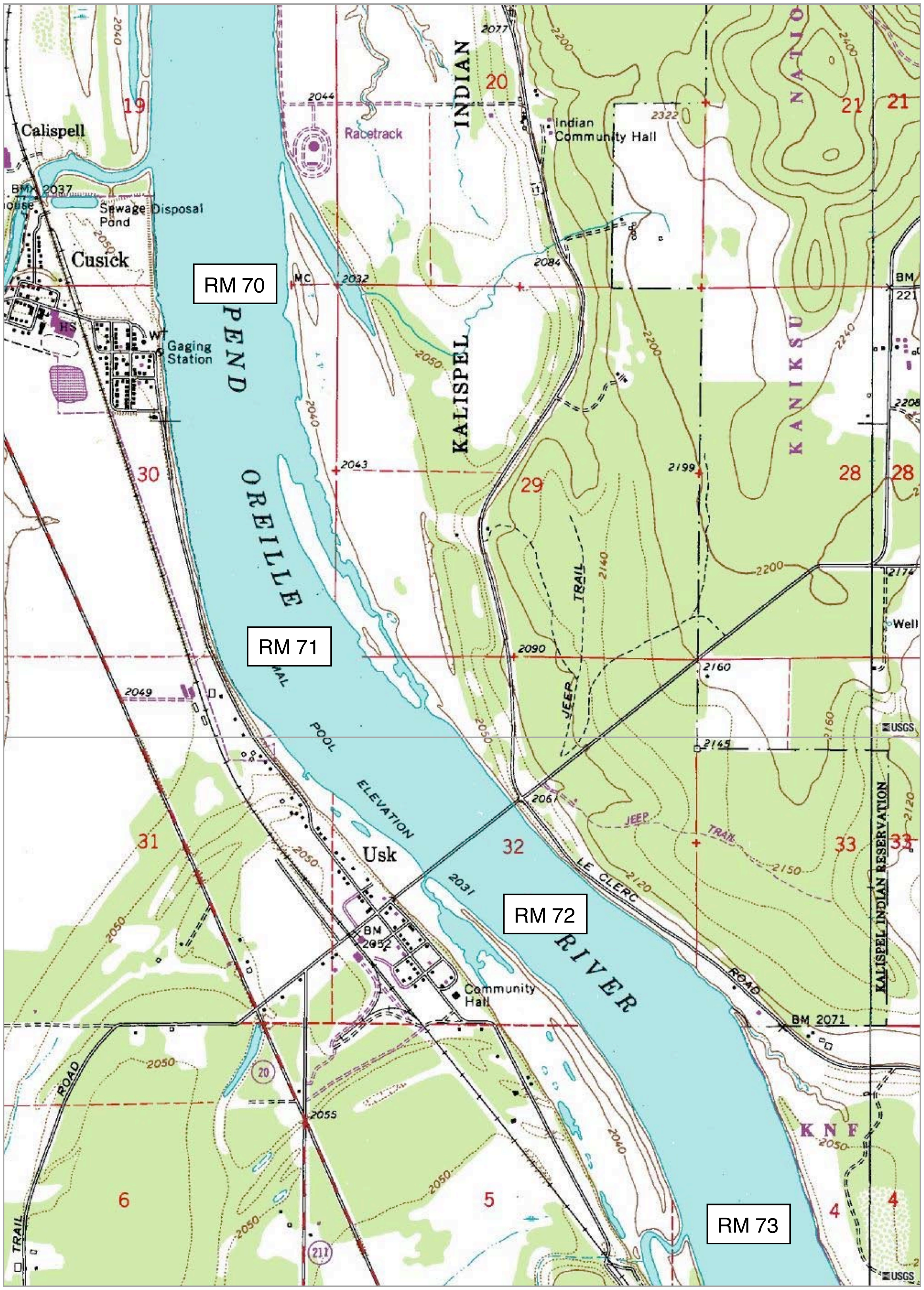


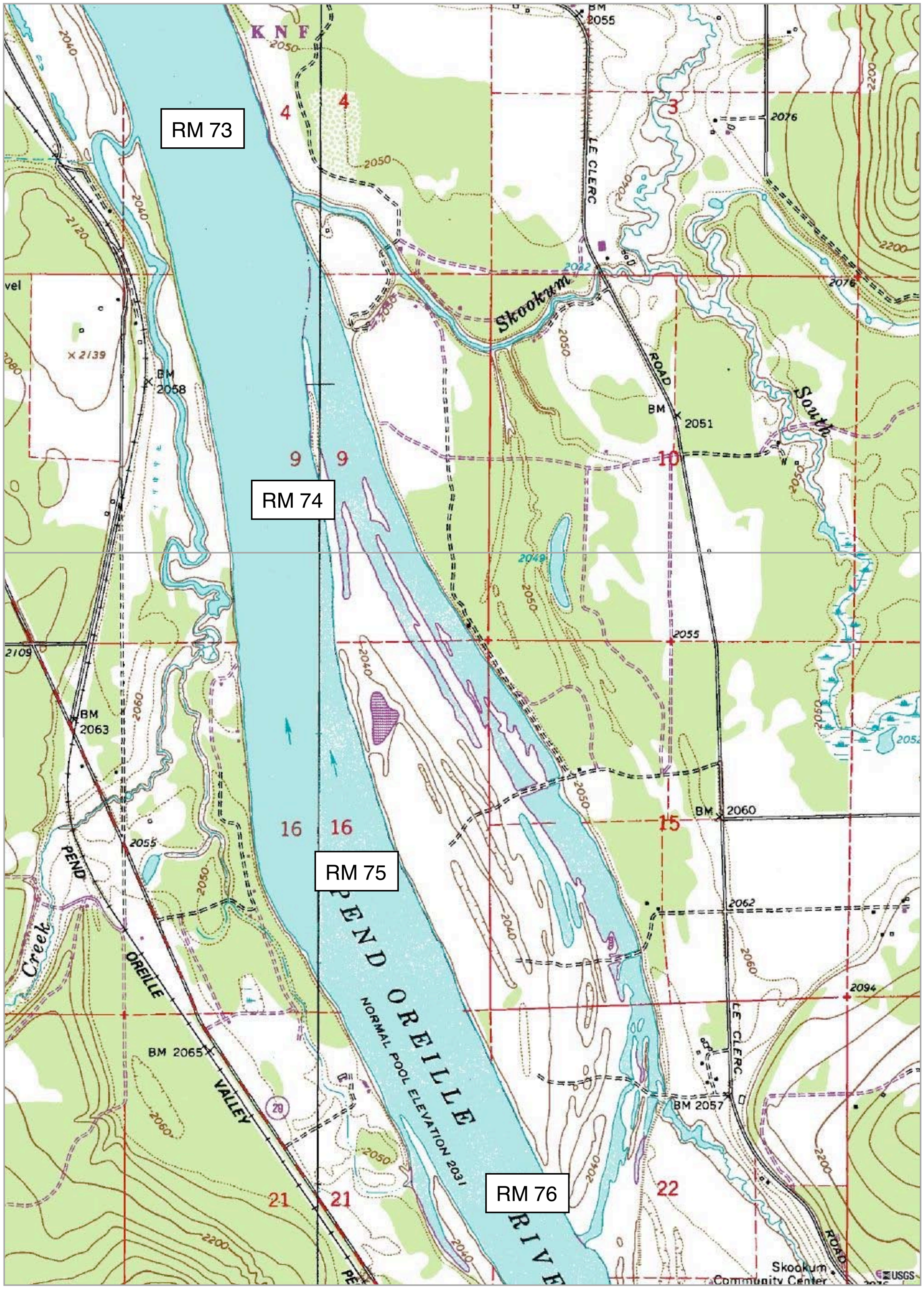
RM 57
RM 58
RM 59
RM 60
RIVER
Babbitz Lake
LITTLE PEND OREILLE STATE WILDLIFE AREA
Mill Creek
Middle Creek
Loop Creek
Racetrack
Spring
VALLEY
LE CLERC
ROAD
Well
BM 2057
BM 2079
BM 2078
BM 2056
BM 2065
USGS

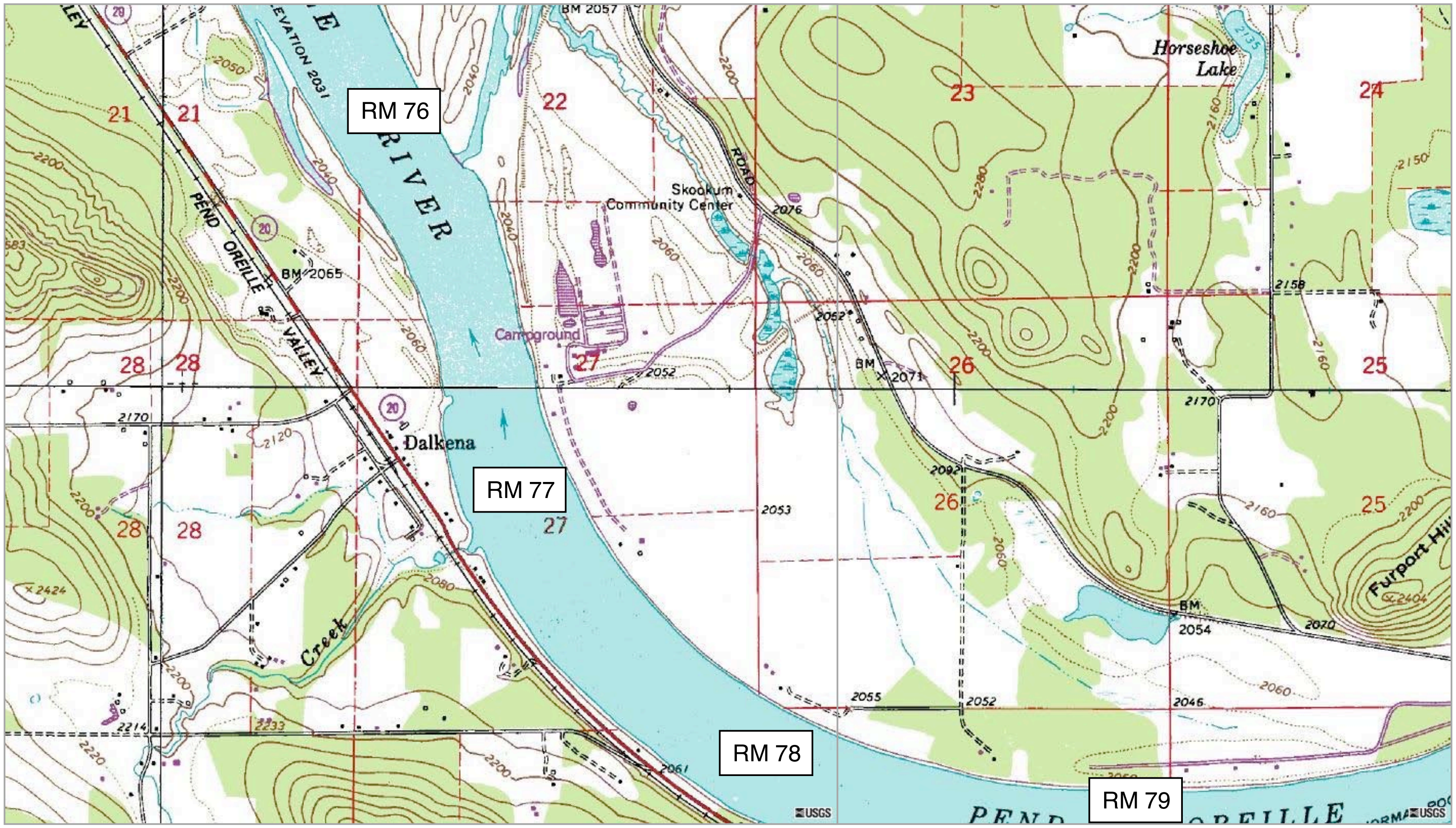

RM 60
RM 61
RM 62
RM 63
PEND OREILLE
Riverside Camp
BM 2061
Jared
BM 2059
PEND OREILLE
VALLEY
Creek
BM 2056
Gravel Pit
Creek
BM 2059
Grange Hall
NORMAL POOL ELEVATION 2031
USGS

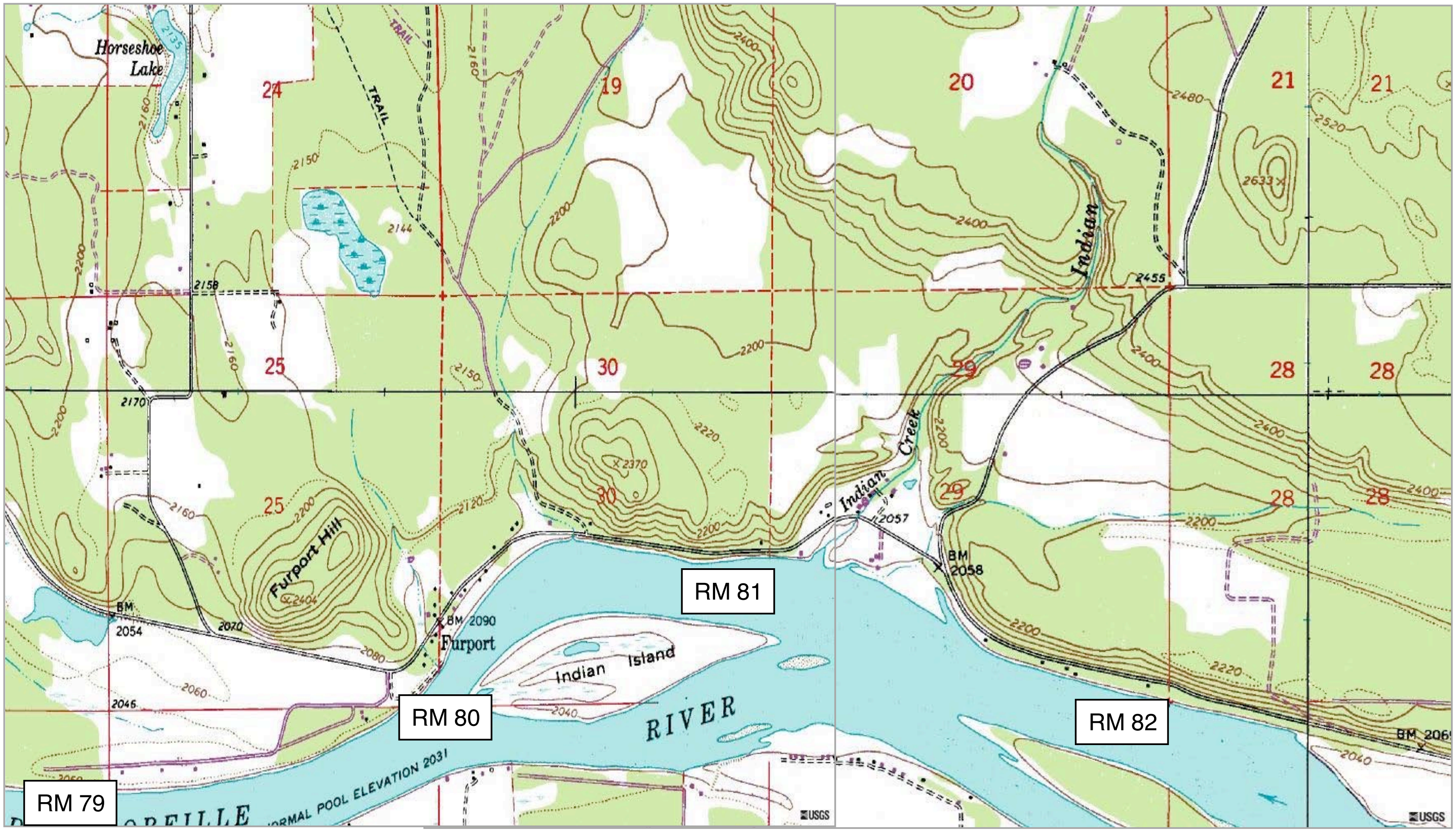

RM 64
RM 65
RM 66
PEND OREILLE RIVER
INDIAN RESERVATION
KALISPEL
LE CLERC ROAD
KANIKSU
Creek
Browns Creek
Half Moon Creek
Cee Cee Ah Cee
Gravel Pits
Gravel Pit
Gibraltar Rock
Manresa Grotto
Picnic Area
BM 2040
T 34 N
T 33 N
19
20
21
28
29
30
31
32
33
4
5
6

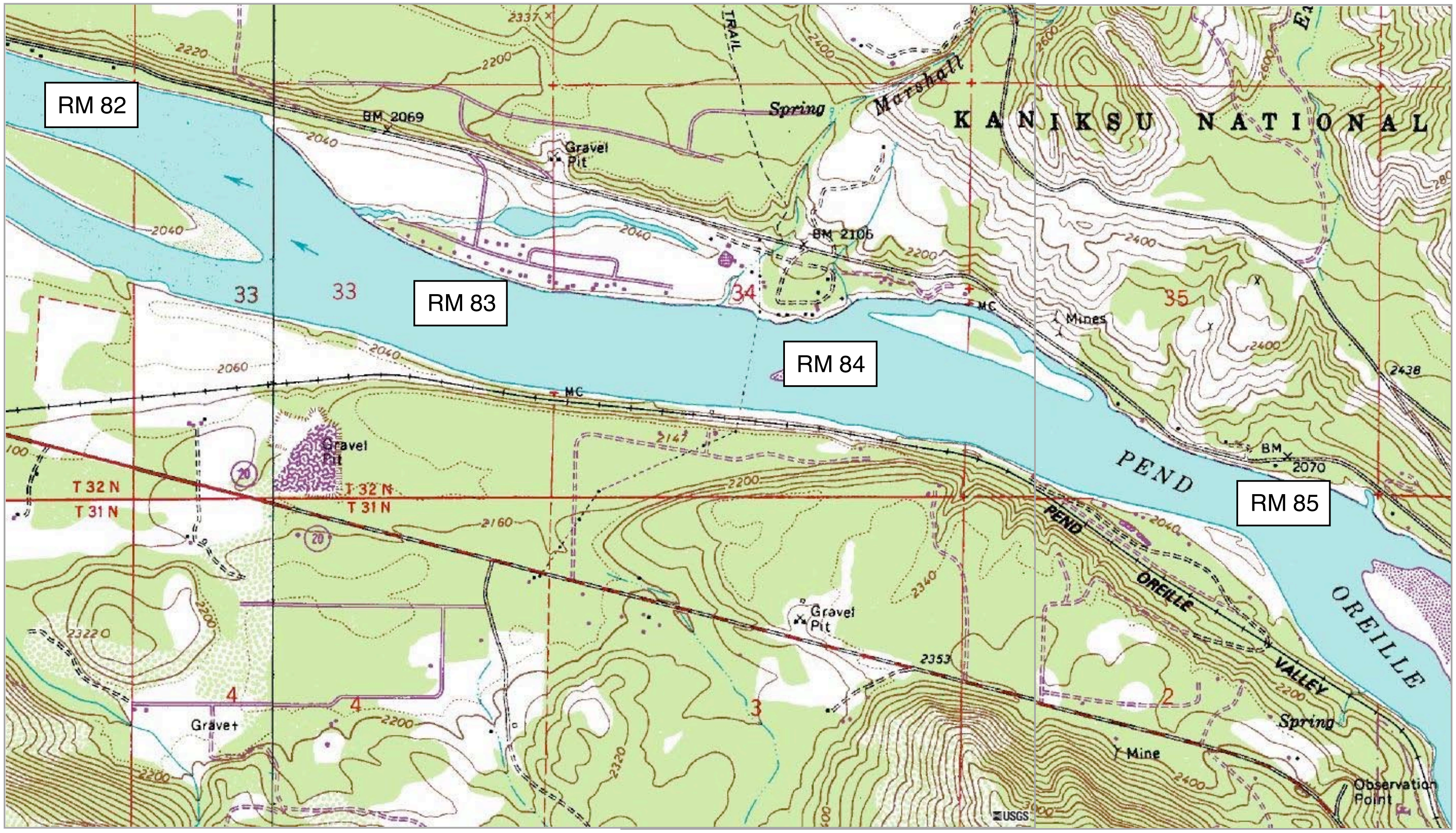

RM 67
RM 68
RM 69
RIVER
KALISPEL
PEND OREILLE
VALLEY
INDIAN RESERVATION
LE CLERC ROAD
NATIONAL FOREST
Gravel Pit
Calispell
Racetrack
Indian Community Hall
RES BDY

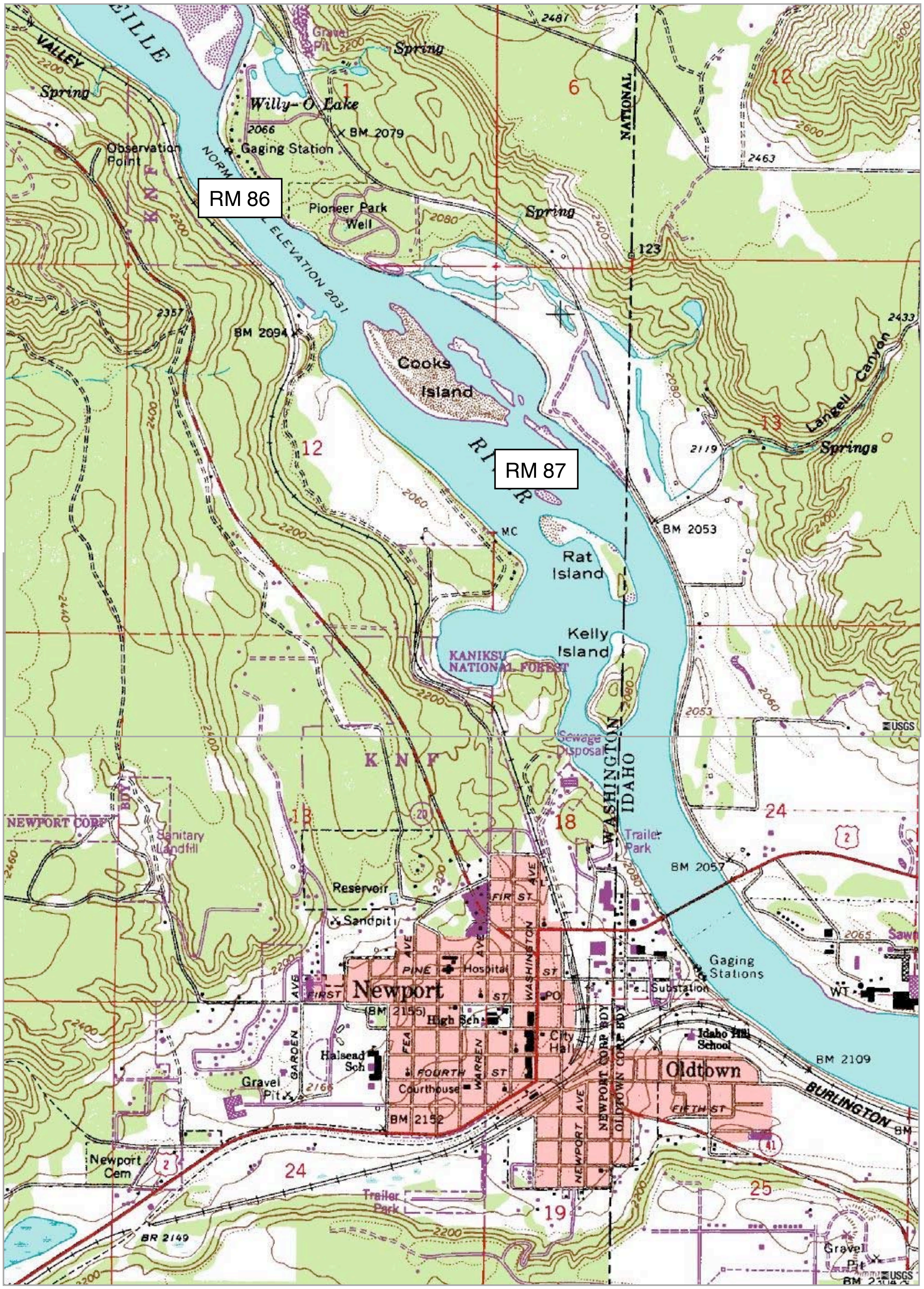

RM 70
RM 71
RM 72
RM 73
PEND OREILLE RIVER
Calispell
Cusick
Sewage Disposal Pond
Gaging Station
Racetrack
Indian Community Hall
KALISPEL INDIAN
KANIKSU NATIO
Usk
Community Hall
NORMAL POOL ELEVATION
LE CLERC ROAD
KALISPEL INDIAN RESERVATION
JEEP TRAIL
TRAIL ROAD
KNF
Well


RM 73
RM 74
RM 75
RM 76
K N F
4
4
3
9
9
10
16
16
15
21
21
22
LE CLERC
ROAD
LE CLERC
ROAD
Skookum
South
Creek
PEND
OREILLE
VALLEY
PEND OREILLE RIVER
NORMAL POOL ELEVATION 2031
BM 2055
BM 2058
BM 2051
BM 2063
BM 2060
BM 2065
BM 2057
x 2139
2076
2094
2062
2055
2109
2049
2052
Skookum Community Center
USGS


RM 76
RM 77
RM 78
RM 79
RIVER
ELEVATION 2031
PEND OREILLE
PEND OREILLE VALLEY
ROAD
Dalkena
Skookum Community Center
Campground
Horseshoe Lake
Furport Hill
Creek
BM 2057
BM 2065
BM 2071
BM 2054
USGS


RM 79
RM 80
RM 81
RM 82
Horseshoe Lake
Furport Hill
Furport
Indian Island
Indian Creek
RIVER
NORMAL POOL ELEVATION 2031
TRAIL
BM 2054
BM 2090
BM 2058
USGS


RM 82
RM 83
RM 84
RM 85
KANIKSU NATIONAL
PEND OREILLE
PEND OREILLE VALLEY
Marshall
Spring
TRAIL
Gravel Pit
BM 2069
BM 2106
BM 2070
Mines
Mine
Grave
Observation Point
T 32 N
T 31 N
USGS


RM 86
RM 87
Cooks Island
Rat Island
Kelly Island
Willy-O Lake
Gaging Station
Observation Point
Pioneer Park Well
NORMAL ELEVATION 2031
RIVER
KANIKSU NATIONAL FOREST
Sewage Disposal
WASHINGTON
IDAHO
Trailer Park
Sanitary Landfill
NEWPORT CORP
Reservoir
Sandpit
Newport
Hospital
High Sch
City Hall
PO
Halsead Sch
Courthouse
Gravel Pit
Newport Cem
Oldtown
Idaho Hill School
Substation
Gaging Stations
BURLINGTON
Langell Canyon
Springs
Spring
VALLEY
BM 2094
BM 2079
BM 2053
BM 2057
BM 2109
BM 2155
BM 2152
BR 2149

Appendix 3 HPA Permit

AGENCY USE ONLY	
Agency Reference #:	Date Received:
Circulated by:	(local govt. or agency)

JOINT AQUATIC RESOURCES PERMIT APPLICATION FORM (JARPA)

(for use in Washington State)

PLEASE TYPE OR PRINT IN BLACK INK.

TO FILL IN ELECTRONICALLY, USE F11 TO MOVE THROUGH THE FORM

☐ Application for a Fish Habitat Enhancement Project per requirements of RCW 77.55.290. You must submit a copy of this completed JARPA application form and the (Fish Habitat Enhancement JARPA Addition) to your local Government Planning Department and Washington Department of Fish & Wildlife Area Habitat Biologist on the same day.

NOTE: LOCAL GOVERNMENTS – You must submit any comments on these projects to WDFW within 15 working days.

Based on the instructions provided, I am sending copies of this application to the following: *(check all that apply)*

- ☐ Local Government for shoreline: ☐Substantial Development ☐Conditional Use ☐Variance ☐Exemption ☐Revision ☐Floodplain Management ☐Critical Areas Ordinance
- ☐ Washington Department of Fish and Wildlife for HPA (Submit 3 copies to WDFW Region)
- ☐ Washington Department of Ecology for 401 Water Quality Certification (to Regional Office-Federal Permit Unit)
- ☐ Washington Department of Natural Resources for Aquatic Resources Use Authorization Notification
- ☐ Corps of Engineers for: ☐ Section 404 ☐ Section 10 permit
- ☐ Coast Guard for: ☐ General Bridge Act Permit ☐ **Private Aids to Navigation** (for non-bridge projects)
- ☐ For Department of Transportation projects only: This project will be designed to meet conditions of the most current Ecology/Department of Transportation Water Quality Implementing Agreement

SECTION A **- Use for all permits covered by this application. Be sure to ALSO complete Section C (Signature Block) for all permit applications.**

1. APPLICANT

MAILING ADDRESS

WORK PHONE	E-MAIL ADDRESS	HOME PHONE	FAX #

If an agent is acting for the applicant during the permit process, complete #2. Be sure agent signs Section C (Signature Block) for all permit applications

2. AUTHORIZED AGENT

MAILING ADDRESS

WORK PHONE	E-MAIL ADDRESS	HOME PHONE	FAX #

3. Relationship of applicant to property: ☐ OWNER ☐ PURCHASER ☐ LESSEE ☐ ________

4. Name, address and phone number of property owner(s) if other than applicant:

5. Location (street address, including city, county and zip code, where proposed activity exists or will occur)

Local government with jurisdiction (city or county)

Waterbody you are working in ________________

Is this waterbody on the 303(d) List** YES ☐ NO ☐

If **YES**, what parameter(s)? ________________

**For 303d List, http://www.ecy.wa.gov/programs/wq/303d/index.html

Tributary of

WRIA #

Shoreline designation

Zoning designation

¼ Section	Section	Township	Range	Government Lot

DNR stream type if known

Latitude and Longitude:

Tax Parcel Number

6. Describe the current use of the property, and structures existing on the property. Have you completed any portion of the proposed activity on this property? ☐ YES ☐ NO
For any portion of the proposed activity already completed on this property, indicate month and year of completion.

Is the property agricultural land? ☐ YES ☐ NO Are you a USDA program participant? ☐ YES ☐ NO

7a. Describe the proposed work that needs aquatic permits: Complete plans and specifications should be provided for all work waterward of the ordinary high water mark or line, including types of equipment to be used. If applying for a shoreline permit, describe all work within and beyond 200 feet of the ordinary high water mark. If you have provided attached materials to describe your project, you still must summarize the proposed work here. Attach a separate sheet if additional space is needed.

PREPARATION OF DRAWINGS: See sample drawings and guidance for completing the drawings. ***ONE SET OF ORIGINAL OR GOOD QUALITY REPRODUCIBLE DRAWINGS MUST BE ATTACHED.*** NOTE: Applicants are encouraged to submit photographs of the project site, but these DO NOT substitute for drawings. ***THE CORPS OF ENGINEERS AND COAST GUARD REQUIRE DRAWINGS ON 8-1/2 X 11 INCH SHEETS. LARGER DRAWINGS MAY BE REQUIRED BY OTHER AGENCIES.***

7b. Describe the purpose of the proposed work and why you want or need to perform it at the site. Please explain any specific needs that have influenced the design.

7c. Describe the potential impacts to characteristic uses of the water body. These uses may include fish and aquatic life, water quality, water supply, recreation and aesthetics. Identify proposed actions to avoid, minimize, and mitigate detrimental impacts and provide proper protection of fish and aquatic life. Identify which guidance documents you have used. Attach a separate sheet if additional space is needed.

7d. For in water construction work, will your project be in compliance with the State of Washington water quality standards for turbidity WAC 173.201A-110? ☐ YES ☐ NO (See USEFUL DEFINITIONS AND INSTRUCTIONS)

8. Will the project be constructed in stages? YES ☐ NO ☐

Proposed starting date:

Estimated duration of activity:

9. Check if any temporary or permanent structures will be placed:

☐ Waterward of the ordinary high water mark or line for fresh or tidal waters AND/OR

☐ Waterward of the mean higher high water for tidal waters?

10. Will fill material (rock, fill, bulkhead, or other material) be placed:

☐ Waterward of the ordinary high water mark or line for fresh waters?

If **YES**, VOLUME (cubic yards) / AREA (acres)

☐ Waterward of the mean higher high water for tidal waters?

If **YES**, VOLUME (cubic yards) / AREA (acres)

11. Will material be placed in wetlands? ☐ YES ☐ NO
If **YES**:
A. Impacted area in acres:
B. Has a delineation been completed? **If YES**, please submit with application. ☐ YES ☐ NO
C. Has a wetland report been prepared? **If YES**, please submit with application ☐ YES ☐ NO
D. Type and composition of fill material (e.g., sand, etc.)
E. Material source:
F. List all soil series (type of soil) located at the project site, and indicate if they are on the county's list of hydric soils. Soils information can be obtained from the natural Resources Conservation Service (NRCS).
G. WILL PROPOSED ACTIVITY CAUSE FLOODING OR DRAINING OF WETLANDS? ☐ YES ☐ NO
If **YES**, IMPACTED AREA IS ________ ACRES OF DRAINED WETLANDS.

NOTE: If your project will impact greater than ½ of an acre of wetland, submit a mitigation plan to the Corps and Ecology for approval along with the JARPA form.
NOTE: A 401 water quality certification will be required from Ecology in addition to an approved mitigation plan if your project impacts wetlands that are: a) greater than ½ acre in size, or b) tidal wetlands or wetlands adjacent to tidal water. Please submit the JARPA form and mitigation plan to Ecology for an individual 401 certification if a) or b) applies.

12. Stormwater Compliance for Nationwide Permits Only: This project is (or will be) designed to meet ecology's most current stormwater manual, or an Ecology approved local stormwater manual. ☐ YES ☐ NO

If **YES** – Which manual will your project be designed to meet? ________

If **NO** – For clean water act Section 401 and 404 permits only – Please submit to Ecology for approval, along with this JARPA application, documentation that demonstrates the stormwater runoff from your project or activity will comply with the water quality standards, WAC 173.201(A)

13. Will excavation or dredging be required in water or wetlands? ☐ YES ☐ NO
If **YES**:
A. Volume: ________ (cubic yards) /area ________ (acre)
B. Composition of material to be removed: ________
C. Disposal site for excavated material: ________
D. Method of dredging: ________

14. Has the State Environmental Policy Act (SEPA) been completed ☐ YES ☐ NO
SEPA Lead Agency: ________
SEPA Decision: DNS, MDNS, EIS, Adoption, Exemption Decision Date (end of comment period)
SUBMIT A **COPY OF YOUR SEPA DECISION LETTER** TO WDFW AS REQUIRED FOR A COMPLETE APPLICATION

15. List other Applications, approvals or certifications from other federal, state or local agencies for any structures, construction discharges or other activities described in the application (i.e. preliminary plat approval, health district approval, building permit, SEPA review, federal energy regulatory commission license (FERC), Forest practices application, etc.). Also, indicate whether work has been completed and indicate all existing work on drawings. NOTE: For use with Corps Nationwide Permits, identify whether your project has or will need an NPDES permit for discharging wastewater and/or stormwater.

TYPE OF APPROVAL	ISSUING AGENCY	IDENTIFICATION NO.	DATE OF APPLICATION	DATE APPROVED	COMPLETED?

16. Has any agency denied approval for the activity you're applying for or for any activity directly related to the activity described herein?
☐ YES ☐ NO
If **YES**, explain:

SECTION B - Use for Shoreline and Corps of Engineers permits only:

17a. Total cost of project. This means the fair market value of the project, including materials, labor, machine rentals, etc.

17b. If a project or any portion of a project receives funding from a federal agency, that agency is responsible for ESA consultation. Please indicate if you will receive federal funds and what federal agency is providing those funds. See instructions for information on ESA.*

FEDERAL FUNDING ☐ YES ☐ NO If **YES**, please list the federal agency.

18. Local government with jurisdiction:

19. For Corps, Coast Guard and DNR permits, provide names, addresses and telephone numbers of adjoining property owners, lessees, etc. ***Please note:*** *Shoreline Management Compliance may require additional notice – consult your local government.*

NAME	ADDRESS	PHONE NUMBER

SECTION C - This section MUST be completed for any permit covered by this application

20. Application is hereby made for a permit or permits to authorize the activities described herein. I certify that I am familiar with the information contained in this application, and that to the best of my knowledge and belief, such information is true, complete, and accurate. I further certify that I possess the authority to undertake the proposed activities. I hereby grant to the agencies to which this application is made, the right to enter the above-described location to inspect the proposed, in-progress or completed work. I agree to start work **ONLY** after all necessary permits have been received.

SIGNATURE OF APPLICANT ______ DATE

SIGNATURE OF AUTHORIZED AGENT ______ DATE

I HEREBY DESIGNATE ______ TO ACT AS MY AGENT IN MATTERS RELATED TO THIS APPLICATION FOR PERMIT(S). I UNDERSTAND THAT IF A FEDERAL PERMIT IS ISSUED, I MUST SIGN THE PERMIT.

SIGNATURE OF APPLICANT ______ DATE

SIGNATURE OF LANDOWNER (EXCEPT PUBLIC ENTITY LANDOWNERS, E.G. DNR)

THIS APPLICATION MUST BE SIGNED BY THE APPLICANT AND THE AGENT, IF AN AUTHORIZED AGENT IS DESIGNATED.

18 U.S.C §1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly falsifies, conceals, or covers up by any trick, scheme, or device a material fact or makes any false, fictitious, or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious, or fraudulent statement or entry, shall be fined not more than $10,000 or imprisoned not more than 5 years or both.

COMPLETED BY LOCAL OFFICIAL

A. Nature of the existing shoreline. (Describe type of shoreline, such as marine, stream, lake, lagoon, marsh, bog, swamp, flood plain, floodway, delta; type of beach, such as accretion, erosion, high bank, low bank, or dike; material such as sand, gravel, mud, clay, rock, riprap; and extent and type of bulkheading, if any)

B. In the event that any of the proposed buildings or structures will exceed a height of thirty-five feet above the average grade level, indicate the approximate location of and number of residential units, existing and potential, that will have an obstructed view:

C. If the application involves a conditional use or variance, set forth in full that portion of the master program which provides that the proposed use may be a conditional use, or, in the case of a variance, from which the variance is being sought:

WASHINGTON
JOINT AQUATIC RESOURCE PERMITS APPLICATION (JARPA)
INSTRUCTIONS, SAMPLE DRAWINGS & AGENCY CONTACTS

NOTE: DO NOT SUBMIT this section with your application.

This Joint Application may be used to apply for Hydraulic Project Approvals, Shoreline Management Permits, Approvals for Exceedance of Water Quality Standards, Water Quality Certifications, Coast Guard Bridge Permits, Department of Natural Resources Use Authorization, and Army Corps of Engineers Permits. ***You must submit readable copies of the completed application form together with detailed drawings, prepared in accordance with the drawing guidance to the appropriate agencies. When applying, you do NOT need to send copies of the instructions.*** Remember, depending on the type of project you are proposing, other permits may be required that are not covered by this application.

☞Use the following list to determine which permits to apply for. Your project may require some or all of these permits. If you have trouble deciding which permits you need, please contact the appropriate agency for questions. Agency telephone numbers are attached. **IF ANY OF THE BOXED ITEMS LISTED UNDER A PERMIT TITLE BELOW APPLY TO YOUR PROJECT, THEN YOU MUST CHECK THE BOX FOR THAT PERMIT ON THE TOP OF PAGE ONE OF THE JARPA FORM AND SEND A COMPLETED COPY OF THE APPLICATION FORM TO THE AGENCY RESPONSIBLE FOR ISSUING THAT PERMIT.** Complete Sections A & C for any of the permits listed below. Also complete Section B for Shoreline and Army Corps of Engineers permits. Detailed drawings are required for any of these permits (see attached drawing guidelines for drawing requirements).

❑ **Hydraulic Project Approval** from the Department of Fish and Wildlife under 77.55 RCW is required if your project includes construction or other work, that:
- will use, divert, obstruct, or change the natural flow or bed of any fresh or salt water of the state. This includes bed reconfiguration, all construction or other work waterward under and over the ordinary high water line, including dry channels, and may include projects landward of the ordinary high water line (e.g., activities outside the ordinary high water line that will directly impact fish life and habitat, falling trees into streams or lakes, dike construction etc.).

❑ **Shoreline Substantial Development, Conditional Use, Variance Permit, or Exemption** from Local Government (under the Shoreline Management Act, 90.58 RCW;) required for work or activity in the 100-year floodplain, or within 200 feet of the ordinary high water mark of Shorelines of the State (check with your local government); and which includes any one of the following:
- dumping;
- drilling;
- dredging;
- filling;
- placement or alteration of structures (whether temporary or permanent); or
- any activity which substantially interferes with normal public use of the waters regardless of cost.

❑ **Floodplain Management Permits and/or Critical Areas Ordinances** review by Local Government for:
- work in frequently flooded areas, geologically unstable areas, wildlife habitats, aquifer recharge areas, and wetlands.

❑ **Section 401 Water Quality Certification** from the Department of Ecology Regional office under 33 USC § 1341 of the Clean Water Act is needed when a federal approval is required for a project, including the following:
- Corps of Engineers 404 Permit –Send to Ecology's Federal Permits Unit in the Regional Office;
- FERC hydropower license--Attach FERC exhibit E or an Applicant Prepared Environmental Assessment and send to the State of Washington's Office of Permit Assistance

❑ **Aquatic Resources Use Authorization Notification** from the Department of Natural Resources is required if your project:
- is on, crosses, or impacts the bedlands, tidelands or shorelands of a navigable water.

❑ **Section 404 Permit** from the Corps of Engineer under 33 USC § 1344 of the Clean Water Act is required if your project includes:
- placement of dredged or fill material waterward of the ordinary high water mark, or the mean higher high tide line in tidal areas, in waters of the United States, **including wetlands***;
- mechanized land clearing and sidecasting in waters of the United States, **including wetlands***.
- Endangered Species Act (ESA) Consultation**

- ☐ **Section 10 Permit** from the Corps of Engineer is required for:
  - any work in or affecting navigable waters of the United States (e.g., floats, piers, docks, dredging, excavation, piling, buoys, overhead power lines, etc.).

- ☐ **General Bridge Act Permit** from the Coast Guard is required for:
  - construction of a new bridge or modification to an existing bridge over a navigable waterway.

- ☐ **Private Aids to Navigation** from the Coast Guard is required for:
  - installing a fixed structure or floating object within the waters of the United States.

*Wetlands that are determined to be isolated by the Army Corp of Engineers are no longer regulated under Section 404 of the Clean Water Act. These wetlands are regulated by the Department of Ecology under the state Clean Water Act RCW 90.48. For further information please contact the Office of Regulatory Assistance at 1-800-917-0043 or at assistance@ora.wa.gov .

** Endangered Species Act (ESA) Consultation with the National Marine Fisheries Service and/or U.S. Fish and Wildlife Service: If your project is authorized, funded or carried out by a Federal agency and the Federal agency determines that the proposed project may affect ESA listed species or critical habitat, consultation under Section 7 of the ESA is required. ESA Consultation is the responsibility of the Federal agency, not the applicant. JARPA forms should be submitted directly to the responsible Federal agency, not to the National Marine Fisheries Service or the U.S. Fish and Wildlife Service. The responsible Federal agency may require additional information from the applicant to assess potential project impacts to listed species and their habitat.

Information on ESA - http://endangered.fws.gov/hcp/index.html or http://endangered.fws.gov/whatwedo.html or http://offices.fws.gov/directory/ListOffices.cfm

USEFUL DEFINITIONS & INSTRUCTIONS

The following definitions are presented to help applicants in completing the JARPA. They may not necessarily represent specific language from the laws implemented through JARPA.

Ordinary High Water Mark or Line means the visible line on the banks where the presence and action of waters are so common as to leave a mark upon the soil or vegetation. In any area where the ordinary high water line cannot be found, the ordinary high water line adjoining saltwater shall be the line of mean higher high water, and the ordinary high water line adjoining freshwater shall be the elevation of the mean annual flood.

Mean Lower Low Water is the 0.0 tidal elevation, determined by averaging each day's lowest tide at a particular location over a period of 19 years. It is the tidal datum for vertical tidal references in the salt water area.

Mean High Water and Mean Higher High Water Tidal Elevations at any specific location can be found in tidal benchmark data compiled by the United States Department of Commerce, Environmental Science Services Administration, Coast and Geodetic Survey, dated January 24, 1979. This information can be obtained from the Corps of Engineers at (206) 764-3495. The determination of tidal elevation is obtained by averaging each day's highest tide at a particular location over a period of 19 years, measured from mean lower low water, which equals 0.0 tidal elevation.

Shorelands or shoreland areas means those lands extending landward for 200 feet in all directions as measured on a horizontal plane from the ordinary high water mark; floodways and contiguous floodplain areas landward 200 feet from such floodways; and all wetlands and river deltas associated with the streams, lakes, and tidal waters which are subject to the provisions of 90.58 RCW.

Shorelines means all water areas of the state, including reservoirs, and their associated wetlands, together with the lands underlying them, except stream segments upstream of the point where mean annual flow is less than 20 cubic feet per second, and lakes less than 20 acres in size.

Wetlands mean areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Bridge means any structure including pipelines and conveyor belts, which transports traffic or materials across a navigable water.

Aquatic Tidelands means the area between the ordinary high tide line and extreme low tide line, unless otherwise established.

Aquatic Shorelands means the shore areas of non-tidal navigable lakes or rivers between the ordinary high water line and the line of navigability unless otherwise established.

Aquatic Bedlands means the area waterward of and below the line of navigability on non-tidal rivers and lakes, or below the extreme low tide mark in navigable tidal waters, or below the outer harbor line where a harbor has been created.

Nationwide Permit issued by the Corps of Engineers for projects with minimal impacts. For a complete packet of nationwide permits and application information, contact the Corps Regulatory branch at (206) 764-3495 or visit their website http://www.nws.usace.army.mil.

Section 303(d) listed waters These are water quality limited estuaries, lakes, and streams that fall short of state surface water quality standards, and are not expected to improve within the next two years.

Mixing zone means that portion of a water body adjacent to an effluent outfall where mixing results in the dilution of the effluent with the receiving water. Water quality criteria may be exceeded in a mixing zone as conditioned and provided for in WAC 173-201A-400.

Turbidity means the clarity of water expressed as nephelometric turbidity units (NTU) and measured with a calibrated turbidimeter.

Background conditions means the biological, chemical, and physical conditions of a water body, outside the area of influence of the discharge under consideration.

Instructions for question 7d.
Water Quality Standards – Compliance for turbidity mixing zone requirements.

The water downstream of the allotted mixing zone (100 ft, 200 ft, 300 ft, dependent on how fast the water is flowing and measured in cubic feet per second) must have the same visual clarity as the water upstream of the project impact site (the water cannot be greater than 5 NTUs above the background water). The following section from WAC 173-201A-110 authorizes the turbidity mixing zone.

All work in or near the water, and water discharged from the site shall meet the State's Water Quality Standards, WAC 173-201A. A mixing zone for turbidity is authorized within WAC 173.201A-030 during and immediately after necessary in-water or shoreline construction activities that result in the disturbance of in-place sediments. Use of a turbidity mixing zone is intended for brief periods of time (such as a few hours or days) and is not an authorization to exceed the turbidity standard for the entire duration of the construction. Use of the mixing zone is subject to the constraints of WAC 173-201A-100(4) and (6), requiring an applicant have supporting information that indicates the use of the mixing zone shall not result in the loss of sensitive or important habitat, substantially interfere with the existing or characteristic uses of the water body, result in damage to the ecosystem, or adversely affect public health. The mixing zone is authorized only after the activity has received all other necessary local and state permits and approvals, and after the implementation of appropriate best management practices to avoid or minimize disturbance of in-place sediments and exceedances of the turbidity criteria. Within the mixing zone, the turbidity standard is waived, and all other applicable water quality standards shall remain in effect. The mixing zone is defined as follows:

1) For waters up to 10 cfs flow at time of construction, the point of compliance shall be 100-feet downstream of project activities.
2) For waters above 10 cfs up to 100 cfs flow at time of construction, the point of compliance shall be 200-feet downstream of project activities.
3) For waters above 100 cfs flow at the time of construction, the point of compliance shall be 300 feet downstream of project activities.
4) For projects working within or along lakes, ponds, wetlands, estuaries, marine waters or other non-flowing waters, the point of compliance shall be at a radius of 150-feet from the activity causing the turbidity exceedance.

GUIDANCE FOR COMPLETION OF DRAWINGS

General Information. Three types of illustrations are needed to properly depict the proposed activity: Vicinity Map, Plan View, and Cross-Sectional View. Drawings to scale should be prepared using clear printing, black ink, and the fewest number of sheets possible. Include the scale. The importance of clear accurate drawings cannot be overstated. At a minimum, drawings must contain the following information; other information may be required depending on project type. If you have questions regarding completing the drawings, call the appropriate agency.

***NOTE:** Army Corps of Engineers drawing requirements are found at: http://www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=REG&pagename=mainpage_Permit_Applicant_Info .

1. Vicinity Map. A copy of a county or city road map, or a U.S. Geological Survey topographic map may be used. Include:
   a. North arrow.
   b. Name of waterbody (and river mile if appropriate).
   c. Location of the proposed activity (indicate with a circle, arrow, X, or similar symbol).
   d. Provide latitude and longitude of the site to the nearest second.
   e. Provide directions to the site.

2. Plan View. This drawing illustrates the proposed project area as if you were looking down at the site from overhead.
   a. North arrow.
   b. Name of waterbody and direction of water flow.
   c. Location of existing shoreline.
      Tidal Waters: Show the Ordinary High, Mean High, Mean Low, Mean Higher High, and Mean Lower Low Water Marks or Lines, and/or wetland boundaries. Indicate elevation above datum.
      Non-tidal waters: Show the Ordinary High Water Mark or Line, Meander Line, and/or wetland boundary.
   d. Dimensions of the activity or structure and impervious surfaces, distance from property lines, and the distance it extends into the waterbody beyond the Ordinary High, Mean High, Mean Higher High, and Mean Low Water Mark or Line, and/or wetland boundaries, as appropriate.
   e. For Corps permits, indicate the distance to Federal projects and/or navigation channels (if applicable). To ascertain, call the Corps Regulatory Branch Office at (206) 764-3495.
   f. Show existing structures on subject and adjoining properties.
   g. Indicate adjoining property ownership.
   h. If fill material is to be placed, identify the type of material, amount of material (cubic yards), and area to be filled (acres).
   i. If project involves dredging, identify the type of material, amount of material (cubic yards), area to be dredged, method of dredging, and location of disposal site. Dredging in areas shallower than -10 feet needs to be clearly identified on drawings.
   j. Identify any part of the activity that has been completed.
   k. Indicate types and location of aquatic, wetland, riparian and upland vegetation.
   l. Erosion control measures, stabilization of disturbed areas, etc.
   m. Utilities, including water, sanitary sewer, power and stormwater conveyance systems (e.g., bioswales).
   n. Indicate stormwater discharge points.
   o. Proposed landscaping where applicable (for complex landscape plans, please attach a separate drawing).
   p. Where applicable, plans for development of areas on or off site as mitigation for impacts associated with the proposal.
   q. On all variance applications the plans shall clearly indicate where development could occur without approval of a variance, the physical features and circumstances on the property that provide a basis for the request, and the location of adjacent structures and uses.

3. Cross-Sectional View. This drawing illustrates the proposed activity as if it were cut from the side and/or front. Include:
   a. Location of water lines.
      Tidal Waters: Show the Ordinary High, Mean High, Mean Higher High, and Mean Lower Low Water Marks or Lines, and/or wetland boundary.
      Non-tidal waters: Show the Ordinary High Water Mark or Line, and/or wetland boundary.
   b. Water depth or tidal elevation at waterward face of project.
   c. Dimensions of the activity or structure, and the distance it extends into the waterbody beyond the Ordinary High, the Mean High, the Mean Higher High and Mean Low Water Mark or Line, and/or wetland boundaries.
   d. Indicate dredge and/or fill grades as appropriate.
   e. Indicate existing and proposed contours and elevations.
   f. Indicate types and location of aquatic, wetland, and riparian vegetation present on site.
   g. Indicate type and location of material used in construction and method of construction.
   h. Indicate height of structure.

4. Clearance and Elevations. Applies to Coast Guard Bridge Permits only.
   a. Vertical clearance measured from Mean Higher (tidal waters) or Ordinary High (non-tidal water).
   b. Horizontal clearance between piers or pilings.
   c. Bottom elevation of the waterway at the bridge.

AGENCY CONTACTS

Below is a list of agencies to which a copy of the Joint Application may be sent, and which permit each agency issues. Technical assistance and information is also available from these offices.

State of Washington Office of Regulatory Assistance

State of Washington Office of Regulatory Assistance
Mailing Address
PO Box 47600
Olympia, WA 98504-7600
Physical Address
300 Desmond Drive
Lacey, WA 98504

Telephone 1-800-917-0043 or (360) 407-7037
Fax (360) 407-6904

Department of the Army Permit(s)(Section 404 or Section 10)

U.S. Army Corps of Engineers,
Seattle District
Regulatory Branch
Post Office Box 3755
Seattle, WA 98124-2255

Telephone (206) 764-3495
FAX (206) 764-6602

U.S. Army Corps of Engineers
Eastern Washington Information
P.O. Box 273
Chattaroy, WA 99003-0273

Telephone (509) 238-4570
FAX (509) 238-4570

U.S. Army Corps of Engineers
Central Washington Information
P.O. Box 2829
Chelan, WA 98816-2829

Telephone (509) 682-7010
FAX (509) 682-7710

Department of Ecology Permits – 401 Water Quality Certification

Washington State Department of Ecology – Headquarters
Mailing Address
Post Office Box 47600
Olympia, WA 98504-7600
Physical Address
300 Desmond Drive
Lacey, WA 98504

Telephone (360) 407-6000

Central Region
15 West Yakima Avenue, Ste 200
Yakima, WA 98902-3401

Telephone (509) 575-2490
FAX (509) 575-2809

Eastern Region
4601 North Monroe, Suite 202
Spokane, WA 99205-1295

Telephone (509) 329-3400
FAX (509) 329-3529

Northwest Region
3190 - 160th Avenue S.E.
Bellevue, WA 98008-5452

Telephone (425) 649-7000
FAX (425) 649-7098

Southwest Region
Mailing Address:
P.O. Box 47775
Olympia, WA 98504-7775
Physical Address:
300 Desmond Drive
Lacey, WA 98504

Telephone (360) 407-6300
FAX (360) 407-6305

Department of Fish and Wildlife (Hydraulic Project Approval) - Submit 3 copies of the JARPA application to Regional offices.
Contact regional offices for questions or assistance.

Headquarters
Washington State Department of Fish and Wildlife
600 Capitol Way North
Olympia, Washington 98501-1091
Telephone (360) 902-2534
TDD (360) 902-2207
FAX (360) 902-2946

Region 1 (Pend Oreille, Ferry, Stevens, Spokane, Lincoln, Whitman, Columbia, Garfield, Asotin, and Walla Walla Counties)
Washington State Department of Fish and Wildlife
8702 North Division Street
Spokane, WA 99218-1199
Telephone (509) 456-4082
FAX (509) 456-4071

Region 2 (Okanogan, Douglas, Grant, Adams, and Chelan Counties)
Washington State Department of Fish and Wildlife
1550 Alder Street NW
Ephrata, WA 98823-9699
Telephone (509) 754-4624
FAX (509) 754-5257

Region 3 (Franklin, Kittitas, Yakima, and Benton Counties)
Washington State Department of Fish and Wildlife
1701 South 24th Avenue
Yakima, WA 98902-5720
Telephone (509) 575-2740
FAX (509) 575-2474

Region 4 (Whatcom, Skagit, Snohomish, King, Island, and San Juan Counties)
Washington State Department of Fish and Wildlife
16018 Mill Creek Boulevard
Mill Creek, WA 98012-1296
Telephone (425) 775-1311
FAX (425) 338-1066

Region 5 (Lewis, Wahkiakum, Cowlitz, Skamania, Clark, and Klickitat Counties)
Washington State Department of Fish and Wildlife
2108 Grand Blvd.
Vancouver, WA 98661-4624
Telephone (360) 696-6211
FAX (360) 906-6776

Region 6 (Pacific, Pierce, Thurston, Grays Harbor, Mason, Jefferson, Clallam, and Kitsap Counties)
Washington State Department of Fish and Wildlife
48 Devonshire Road
Montesano, WA 98563-9618
Telephone (360) 249-4628
FAX (360) 664-0689

Local Government (Shoreline Management Act Approval)
Appropriate City or County Planning, Building, or Community Development Department
Refer to: http://www.ora.wa.gov/counties/index.htm for city and county contact information.

Natural Resources Conservation Service (NRCS), formerly Soil Conservation Service (SCS) for information regarding activities on agricultural land
NRCS
West 316 Boone Avenue, Suite 450
Spokane, WA 99201-2348
Telephone (509) 323-2900
FAX (509) 323-2909

Coast Guard

Section 9 Bridge Permit
Commander 13th Coast Guard District (OAN) Telephone (206) 220-7282
915 Second Avenue. Room 3510
Seattle, WA 98174-1067
Attn: Bridge Administrator
FAX (206) 220-7265

Private Aids to Navigation
Commander 13th Coast Guard District (OAN)
915 Second Avenue, Room 3510
Seattle, WA 98174-1067
Attn: PATON Manager
Telephone (206) 220-7285
FAX (206) 220-7265

Department of Natural Resources, Aquatic Resources Authorization to use bedlands, tidelands, or shorelands of navigable waters.

Headquarters	Telephone (360) 902-1000
Northwest Region	Telephone (360) 856-3500
Pacific Cascade Region	Telephone (360) 577-2025
South Puget Sound Region	Telephone (360) 825-1631
Northeast Region	Telephone (509) 684-7474
Southeast Region	Telephone (509) 925-8510
Olympic Region	Telephone (360) 374-6131

Application for Streamlined Process for
FISH HABITAT ENHANCEMENT PROJECTS
Addition to the Joint Aquatic Permit Application Form (JARPA)

Under recent laws, you may qualify for a streamlined permit process with no fees, if your project is designed to enhance fish habitat. If your project meets the requirements below, you are entitled to the streamlined Hydraulic Project Approval (HPA) process, exemption from the State Environmental Policy Act, and exemption from all local government permits and fees. To apply for the exemption process, the applicant must provide on the same day, the JARPA form and this cover addition to: the Department of Fish and Wildlife (WDFW) and all applicable Local Government planning and permitting departments. Local governments have 15-days to provide comments to WDFW, who will use these comments to aid them in making decisions (see below for details).

APPLICANTS - ***To QUALIFY for the fish habitat enhancement exemption you must check at least one each from A and B:***

A) Projects must accomplish one or more of the following fish habitat restoration tasks (check which one applies):

- ❑ Removal of human-made fish passage barriers; or
- ❑ Restoration of an eroded or unstable stream bank using bioengineering techniques; or
- ❑ Placement of woody debris or other in-stream structures that benefit naturally reproducing fish stocks.

AND

B) Projects must **also** be approved in one or more of the following ways (check which apply, and provide details as requested):

- ❑ By WDFW, through the Salmon Enhancement, or Volunteer Cooperative Fish and Wildlife Enhancement Programs; ***Provide project name, and who at WDFW approved the project*** ______________________;
- ❑ By the sponsor of a watershed restoration plan as provided in chapter 89.08RCW; ***Provide title of plan and date, and approving or sponsoring agency*** ______________________;
- ❑ By the Department of Fish and Wildlife as a department-sponsored fish enhancement or restoration project;
- ❑ Through the review and approval process for the Jobs for the Environment program;
- ❑ Through the review and approval process for Conservation District sponsored projects, where the project complies with design standards established by the conservation commission through interagency agreement with the United States Fish and Wildlife Service and the Natural Resource Conservation Service; ***Provide approval date and name of Conservation District approving project*** ______________________; or
- ❑ Through a formal grant program established by the legislature or the Department of Fish and Wildlife for fish habitat enhancement or restoration (currently the Dept. of Transportation is handling grant applications – contact Peter Downey at (360) 705-7492 for information) ***Provide grant application date ______, and circle status- Approved, Denied, or Pending.***

To APPLY for the Exemption – if you have checked a box from both A and B above, complete the following:

1) Submit this cover letter and a complete JARPA form as an application for the fish habitat enhancement exemption to the Local Government planning department, and WDFW. **These applications must be submitted on the same day** starting a 15-day comment period. If significant concerns are raised during the 15-day comment period regarding adverse impacts that cannot be addressed through HPA conditions, WDFW can determine that the project does not qualify for the exemption process. If this determination is made, the applicant may re-apply to WDFW, the applicable Local Government, and any other applicable permitting agency for approval under the full permitting process.
   Provide 1) name and number of habitat biologist at WDFW you applied to ______________________,
   and 2) what local government you applied to ______________________;
2) Apply for all other Federal and State permits needed as defined in the JARPA form. (Fill in waters of the state will require a 404 permit from the Corps of Engineers, and possibly a 401 Water Quality Certification from Ecology).
3) The only work covered by the exemption process must be for fish habitat enhancement. If only a piece of your project is for habitat enhancement, the remainder of the project must be covered by the full permitting process.
4) If WDFW determines that your project meets the criteria for the exemption, your project is exempt from SEPA and from local government permits and fees. You will have an answer from WDFW within 45 days of the receipt of this cover letter and complete JARPA form.

LOCAL GOVERNMENTS: PLEASE NOTE – ***you only have 15 days to review the projects and provide comments to WDFW or your comments will be considered waived. Per the new law, you are responsible for the following:***

1. You must accept the JARPA application form and this revised cover addition for project review;

2. If the Local Government chooses to comment on the project, comments (support or objection) must be provided to the WDFW local habitat biologist responsible for the project area within 15-days of receipt of the JARPA form;

3. If determined by WDFW that the project meets the habitat enhancement exemption criteria, SEPA and all local government permits are considered exempt and consistent with the revisions to the WACs, and local government fees are waived.

4. The law determines that "fish habitat enhancement projects that conform to the provisions of the act are determined to be consistent with local shoreline master programs".

DEPARTMENT OF FISH AND WILDLIFE:

1. Upon receipt of a complete JARPA and request for the fish habitat exemption process, review the proposed project plan for compliance with the requirements listed in section 1 and 2 of 2SHB 2879 (also listed on page 1, applicant section #A and B).
   a) If JARPA is incomplete or if it is determined that a project does NOT meet the exemption criteria, contact the applicant and local government planning department and inform them the project does not qualify for the exemption. Return JARPA to the applicant. The applicant may reapply to WDFW, the applicable Local Government and other permitting agencies for approval under the full permitting process.
   b) If JARPA is complete and the project meets the criteria, start the HPA 45-day exemption process (defined below);

1. WDFW must allow 15 days for interested parties, and local governments to provide comments on the project – no approval action can be taken within the first 15 days of receipt of the JARPA;

2. If comments are received, WDFW will decide whether the concerns raised can be mitigated through conditions of the HPA – if yes, continue to #4. If no, WDFW will notify the applicant and applicable Local Government. The applicant may reapply to WDFW, the applicable Local Government and other permitting agencies for approval under the full permitting process;

3. WDFW must approve or deny the HPA, or make a determination that the proposed work does not qualify for the exemption process within 45 days.